SCIENCE AND INDUSTRY

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POPULAR AVIATION

NOVEMBER 1933
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FAIRCHILD
"22"

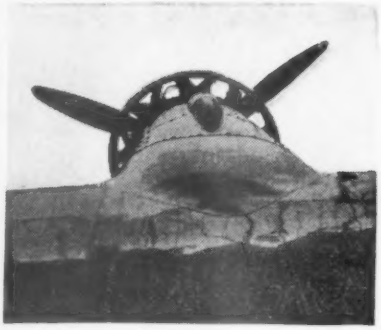
Testing Racing Planes
By **JIMMY DOOLITTLE**

Some Inspectors I Have Met

XUM

New Features for the December P. A.

A Bigger and Better Issue



Detail of the engine mounting on the Boeing "247" transport plane—a detail for model contestants.

THIS special announcement carries news that is of interest to every reader of POPULAR AVIATION. Don't miss the December issue, nor any of the succeeding issues.

Racing and pylon polishing do not advance the best interests of aviation. Read our argument on this subject.

CLIP this coupon, fill it out and mail it with $1.00 for the special five month introductory subscription. This enables you to gain all of the advantages of a subscription at small cost.

Editorial Comment

POPULAR AVIATION has always been a fine magazine—thousands of our readers have told us that—but the December issue and the succeeding issues for 1934 will be still better because of the new plans that we have worked out.

* * *

FIRST OF ALL, will be the editorial replies to the comments made by our readers on "Levitation" and the "Air Races Are a Menace." And you may believe that these arguments will be hot, furious and thrilling. Don't miss this by any means.

* * *

OUR PHOTO PHANS will be pleased to know that our series of full page air plane pictures will be resumed at an early date at the request of hundreds of readers.

* * *

OF GREAT INTEREST to those of our readers, who are making a serious study of aeronautics, will be the announcement of a new series of note-book pages that can be clipped out and filed in a standard binder for reference.

* * *

THEN, one of our foremost structural engineers, a specialist on indeterminates in stress analysis, will criticise the engineering features of recent rigid dirigibles. This startling non-technical article will let light into the present dirigible situation.

* * *

THIS YEAR is the 150th anniversary of the balloon. In 1783, Benjamin Franklin witnessed the first ascension of the Montgolfier Brothers in Paris—and we'll have a good story on this subject.

* * *

POPULAR AVIATION is arranging for a master contest in which the first prize will be a real flying lightplane. Will tell you all about it later.

* * *

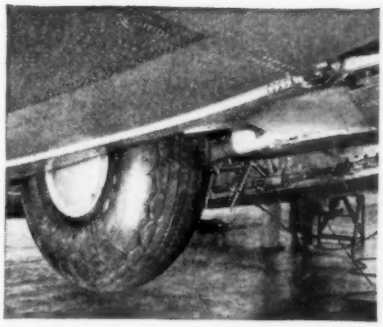
AND then, we have another model contest under advisement—The Mid-year Freak Model Contest open to models of original design. We will let you in on this secret as soon as the present model contest closes.

* * *

OUR SECOND Annual Model Airplane Contest is now going full blast. The parting instructions to the entrants will be found in the December issue. Don't delay.

* * *

DON'T miss the December issue. Insure yourself by sending in the attached coupon for the special five-month subscription. Just think, five months of P. A. for $1.00.



Here's the retractable landing-gear wheel of the Boeing "247", another idea for the P. A. Contest.

POPULAR AVIATION has the largest sale of any aviation magazine for the reason that it covers all branches of aeronautics. It appeals to all classes of readers.

Modern airships are in their infancy. Little is known definitely about their structures.

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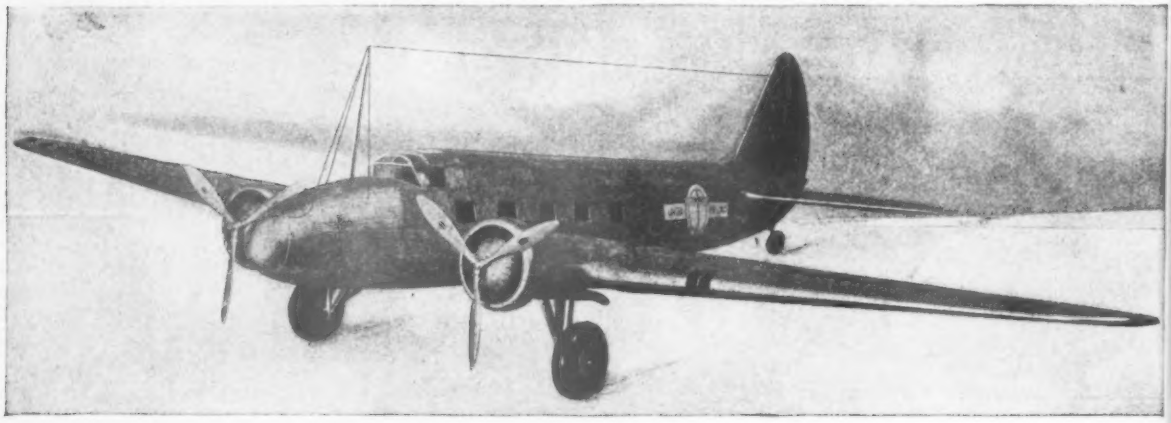
Get a heaping share of the fun by building authentic models



Be up among the winners with this beautiful C-D BOEING 247

Everywhere you hear model builders talking about this sensationally realistic 3/4" scale model with its big 55 5/8 inch span, 38 5/8" length and 16 oz. weight. It's a startling all silver beauty—and like all C-D models, puts on a real show when flying. It's capable of exceptionally good flights, for flights of over 250 feet were quite easily obtained with the same model pictured here. We were about as surprised after testing this ship as we were after the Laird Super-Solution was designed. Honestly, we did not think much about its flying ability, although we did know it would make some flights, but after testing it, it flew beyond all expectation. In many cases it reached an altitude of 40 feet, looking just like the big ship itself, only for the fact that the wheels do not retract (which is impossible because of the rubber motors being so low in the wing).

Powered with rubber strands, made in the orthodox C-D manner (except for the larger structural members such as wing beams which are of the girder type) and generally of balsa, paper, music wire, furnished with standard Cleveland dopes and cements. Motor sticks are removable, so when displayed, it looks like an exhibition model. Just the thing for the Popular Aviation Contest.
The Kit comes complete for a flying or exhibition model with all materials necessary, including partly

Hailed Everywhere as a Masterpiece in Authentic Flying Model Aircraft!

finished nose block, ready furnished cowls, completed "bronze bushed" wheels, stout axle material to withstand the severe landing shocks, all the dopes necessary and extra heavy covering paper.
Complete Kit SF-35, as described above and including two panels of full size, completely detailed, copyrighted drawings (2 panels 34" x 44"), containing every bit of information necessary for building the model, shipped anywhere in the U. S. by express in a strong wooden box 4 x 7 1/4 x 40", (contains a large quantity of special materials, dope, cements, etc.), shipping charges "express collect" (wt. 10 lbs.)—for only..... $6.50
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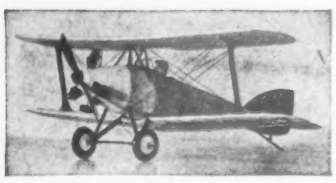
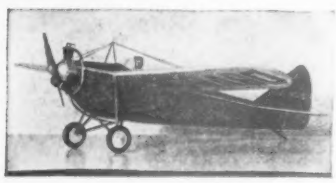


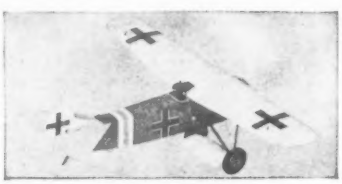
LINCOLN SPORTPLANE

3/4" scale, and flies beautifully. Span 15", length 12 1/8", weight 1 oz. Colored cream and black tail, details and trimming. Complete Kit SF-36 (with everything, including printed out wood parts except pilot, but you can easily carve one out of balsa) at dealers, or postfree..... $1.50



BUHL BULL-PUP

The picture doesn't do this keen little model justice. She's keen in looks—keen in flight. 3/4" scale. Span 22 1/2", length 15", weight 1.9 oz. Colored standard yellow wings and tail, balance blue, details black. Kit SF-38 (with everything needed, including printed out wood parts—but without pilot) at dealers, or postfree, only..... $1.75



FOKKER D-8

Its span is 20 3/4", its length is 14 1/2", weighs 2.5 oz. It is colored blue fuselage, wheels and struts, cream wings, tail surfaces, nose and axle wing, details black. Kit includes authentic drawing, complete parts for making the entire machine, including material for making up rotary motor which actually revolves with the propeller, completely printed out wood, cements, dopes, complete straight type German cross insignia and red and white identification stripes around the rear of the fuselage, etc. Complete Kit SF-34, (except pilot) only..... $2.00

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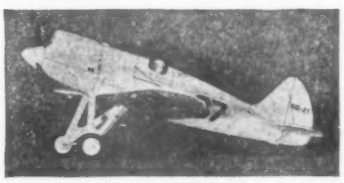

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All Howard enthusiasts will want this much finer classier re-designed model. In fact, all model lovers will get a thrill out of it. Beginners will find it simple to build—experts will thrill at its detail, and realism. 3/4" scale. Colored all white, black details. Span 15", length 13 1/4", weight 1.5 oz. Complete Kit SF-18B (everything including printed out balsa, except pilot) at dealers, or postfree $1.50

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An Airy Chat With the Editor

WE LOOK back on the flying season, just passed, with great satisfaction. It was a season of unusual aeronautic activity in nearly all branches of aviation and showed a marked improvement over the corresponding season of 1932.

Undoubtedly, the general public are becoming more and more airminded. This is proved by the fact that the commercial air lines are more than holding their own during a national depression, hence we can look forward to enormous advances in the more prosperous times to come.

* * *

AND not the least of the reasons for this airminded attitude of the public are the educational features staged by the Century of Progress exhibition in Chicago. Every phase of flying was dwelt upon at this outstanding show and also at the various aviation centers spread out around the outskirts of the city. The crowds kept the passenger hopping planes working overtime. The exhibits were haunted by men and women who previously had not contacted this new science.

* * *

IT WAS a great pleasure for us to meet so many of our readers during the exhibition. We are flattered by their attention and interest in this publication—an interest that led so many of them to go out of their way to visit the office and give us a cheerful "howdy".

* * *

AERONAUTICALLY speaking, something is going to happen in the state of Illinois for Governor Horner has just appointed a new aeronautical commission to succeed the Landis powered outfit that was abolished several months ago.

Now, while we are not acquainted with many of the men on this commission, we are well acquainted with the past performance of Commander Eugene F. MacDonald who in past years capably defended the radio public from the greed of corporate interests. If he is still running true to form, he'll surely give a break to the aviation amateur just as he made life possible for the radio fans of years past. We will watch his action with interest—and hope.

JUST as we predicted, two more valuable lives were needlessly sacrificed at the International Air Races, Chicago, for the edification of a morbid public. According to the promoters, they died in the interests of science, but just how science is advanced by chasing a second-hand Gee-Bee around the pylons is a mystery to us. Anyhow, the attendance was good, the 50 cent pieces rattled into the gate at a satisfactory speed and this is a science in these days!

* * *

"I AIN'T wishin' those guys any bad luck, but if they're going to crash I hope it'll be where I can see it." This was the sentiment expressed by 64 spectators at the International Air Races out of a total of 86 persons interviewed by P.A.'s Inquiring Reporter. These races have a great and civilizing influence on the public, have they not?

* * *

"NOT FOR me—keep your million dollars," was another common remark made by the public after viewing the various death-defying stunts and the hazardous pylon polishing. Do you think after viewing a carnival of speed, such as this, that John J. Public will be enthused to the point where he will purchase a plane for himself and family? Well, if you believe this, we do not.

* * *

DEAD men tell no tales. We just wonder how many crashes have been charged up to the departed pilot by coroners' juries, etc., that properly should be attributed to other causes. Sometimes this is politic and sometimes is considered most highly desirable by certain parties who actually are contributers to the accident.

* * *

HOW many of you have yearned for a transcontinental trip in an ultra-modern transport plane? I'm willing to bet that this includes at least 99.44 percent of our readers—young and old. Well, if you'll turn back to the model section you will find how this can be arranged, and if you qualify, the trip will not cost you one red cent! Then, there are other awards that will be made to the lucky contestants in this most recent offering to P. A.'s readers.

WHO IS going to solve this weather problem? How long will it be before airplanes can sail along on a straight invariable course without turning off to dodge line-squalls and the like? Flying and landing in fogs is now a matter of instrument reading or radio signals, but the summer thunder-storm and the northeast blizzard still have their own way.

* * *

THE good 'ole Barter and Exchange department is rolling merrily along but its way would be far more merry if you fellows would please print your names and addresses so that we can read them. Every now and again we are completely stumped by a blurry scribble which might be Smith, Jones, Goldschmidt or Hassenpfeffer for all we can make out of it. Please, for your own sake as well as my peace of mind—print it!

* * *

THEY do read the Airy Chat once in a while and I can prove it. The first proof to this effect is a constructive letter from B. M. McKoin, M.D., 321 Wood St., Monroe, La., who voices his opinion as follows.

I believe you have the right idea as expressed in your editorial, POPULAR AVIATION, *Volume XIII, No. 2, regarding emergency landing fields. I believe most pilots fly by highways, railroads and rivers more than by any other method and certainly this should make flying safer for beginners who nearly all follow such courses.*

I trust that you may keep up the good work, and while they are hunting work for the unemployed, this could be a program also worth while for future airmen.

Lest you forget, this paragraph in the Airy Chat advocated the construction of landing fields on extensions made to public highways. A very interesting letter that came from a county roads commissioner, who by his own request will not be mentioned by name or address, was not so favorable. His opinion, emphatically stated, can be summed up in one of his phrases, "such procedure would gum up the traffic, add to the tax burden and make life hell for the commissioner." Oh,

(*Continued on page* 332)

POPULAR AVIATION

Including SOUTHERN AVIATION and AERONAUTICS

A MAGAZINE FOR THE PROMOTION OF AMATEUR AVIATION AND PRIVATE FLYING

Volume XIII NOVEMBER, 1933 Number 5

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All-Weather Flying is

Blind flight training with student concealed under Blindfolding hood in front cockpit. Scene taken at the Boeing School of Aeronautics, Oakland, California.

by

HOWARD B. KASTER

Expert in aeronautical features relating to education and flight training methods.

"PILOTS!" snorted an old-timer on the transcontinental the other night, as he went about his business of checking weather maps, and noting balloon observations, "they ought to call us flying scientists."

His observation should not be taken too lightly, for before completing his night's run he was required to coordinate his knowledge of instruments, with which his panel is generously filled, with quick and expert use of the radio beam, meteorology, navigation and general communication.

Air transportation today and tonight would be practically impossible were not the pilot able to coordinate these various agencies for determination of position and conditions as to the course to be pursued during flight. Transport pilots carry their loads through under weather conditions that would have grounded them not long ago; conditions, too, which are perfectly safe for travel when science enables them to look through "weather."

It is, of course, not possible to fix a situation and say in a few words exactly how a given pilot utilizes the material at hand. I shall, however, select isolated cases and reveal something of the methods which will give a clearer idea of the problems faced by the transport pilot, both before and during flight. These will reveal some of the complexities not at all apparent to the casual passenger.

To begin, pilots do not fly "by-guess-and-by-gosh" today. Their specialization in the sciences applicable to their profession begins, not in barnstorming, but in a well-recognized school. Incidentally, both the student pilot and the student mechanic at the Boeing School of Aeronautics receive instruction in instruments and meteorology, the pilots studying also navigation and advanced courses in meteorology. Both classes of students study radio communications.

Were we in the tropics, where competition of such high order does not exist, we could wait for good weather. But in the United States air transportation is competitive from every angle. Combinations of all methods must be brought to bear.

So, the pilot must be a fairly practical navigator, have a good working knowledge of meteorology and be able to fly both by instrument and the invisible radio beam. To do this he not only must have had experience in flying under adverse conditions, but also recognize the limitations of instruments and his methods.

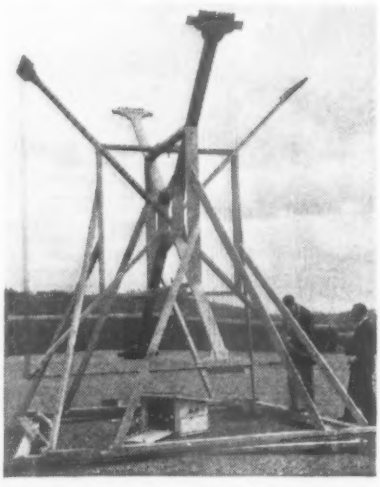
Receiving and transmitting messages to the planes from the ground radio station.

Take a concrete case of navigation. When Pacific Air Transport changed its Oakland-Medford run to include Sacramento (east of this line) the pilots found it necessary to navigate their way northward from Sacramento. Later, of course, when they became familiar with the terrain, they frequently followed their noses in a straight line to their destination. Had they not been proficient navigators, they would, perforce, have returned to Oakland area for a fresh start along the second leg of their flight.

SOMEWHAT more specifically, though, how does the pilot bring these forces of science to bear on his job of getting his load through thick weather?

Take the case of Pilot Jones, scheduled to take the 11:45 p. m. out from Oakland for Salt Lake City. He reports an hour early. During that period he performs tasks and gathers information of value equal to his actual piloting.

His first concern, on reaching the field, is to bring up to date his knowledge of the weather where he left off on arriving from Salt Lake City the previous afternoon. Weather maps have been prepared from data gathered



The directive radio-beam transmitter loop that takes the place of the straight antenna.

An Established Fact

MODERN scientific methods of battling bad weather are making rapid progress. Radio beacons, radio communication of weather forecasts, blind-flying instruments and special meteorological training, are making air transportation as safe or safer than rail transport.

Here, the author takes up, very completely, the various phases of student training in blind flight and in all-weather flying, essentials of modern air line operation.

over the teletype every four hours during the intervening period.

He does not glance casually at these maps. He becomes his own weather expert. From these maps he develops his own forecast of conditions he is likely to encounter along the route. If the weather is critical he must weigh all factors and decide whether the flight should be attempted. If so, he studies the maps critically and decides where he will encounter the worst conditions of visibility, whether and on which side of his regular route he will find better weather.

Nor is this all. Before taking off, Jones notes the pilot balloon observations, learning from them, wind velocities and directions at various levels. On the basis of these, he decides at what elevation to fly. Naturally he will choose an elevation where he will find most favorable winds. Now he takes off.

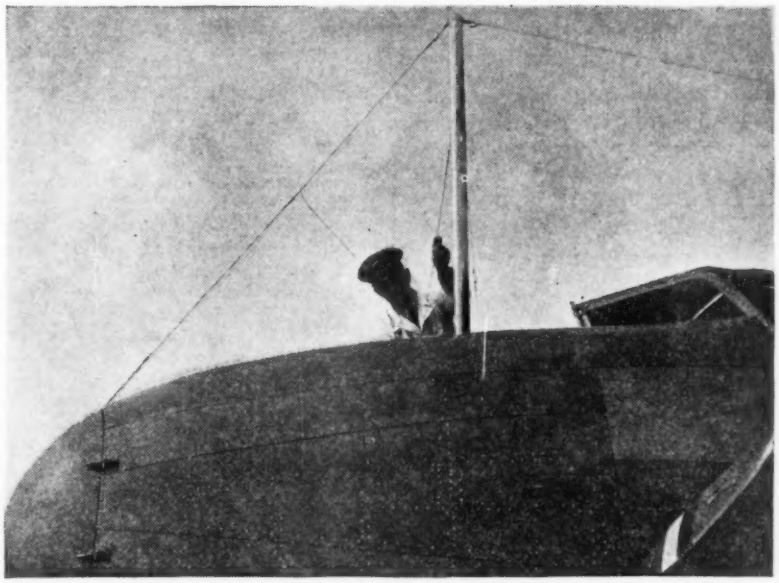
Upon reaching the desired altitude, say 6,000 feet with a 15-mile following wind, he sets out on a compass course, navigating rather than following land marks. The experienced and properly trained pilot depends more upon his instruments than upon "feeling," for, once on his course, he estimates the drift angle and the correction to his compass angle in order to follow the beaten track. Should he encounter bad weather he may follow the radio beams from station to station.

Meantime, he faces bad wind conditions and possibly ice. Even while on the beam, he hears a periodic weather report. For additional safety he may call in and ask about the weather at any time. Never is he more distantly removed from up-to-second weather information than 10 minutes during time of stress.

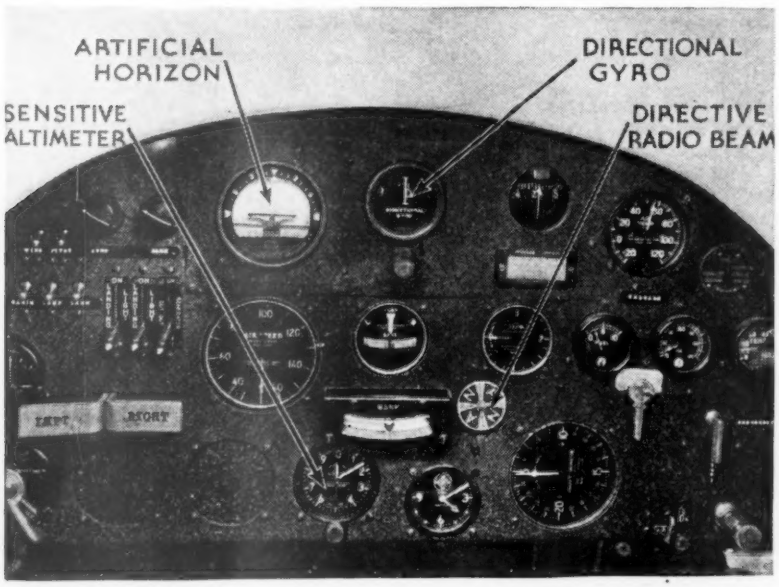
A big danger is ice. Jones' knowledge of ice-forming conditions and how to escape them may prove his salvation. He knows both from theoretical training and practical experience that ice collecting on the wings will increase the drag enormously, change the wing's shape and cause the ship to lose speed and altitude. If he is flying in subcooled rain drops, due to the inversion of temperature, and ice begins to form, he knows that by climbing he can rise free from this menace.

But—there are times when he dare not climb. The condition aloft may be even worse. The entire situation will develop in a very few minutes. While riding the beam, listening to weather reports and keeping a sharp lookout ahead, he must determine, primarily from a previous study of the weather maps, whether to go up or down. Here meteorology is very important.

I RECALL the situation of a pilot flying between cloud layers at 8,000 feet, northbound at night near Redding, California. As he proceeded, a storm closed in. At last he wisely turned back and, among the mountains surrounding Dunsmuir, ran into icing conditions. He knew this resulted from a temperature inversion, so he climbed quickly into warmer air. Had he not been trained in meteorology, he prob-



Proper adjustment of the plane's radio antenna requires special training and experience. Here, a radio man of United Air Lines is shown adjusting an antenna on the Boeing "247".

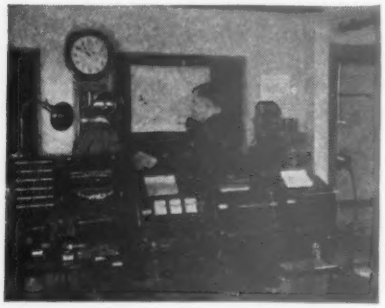


An airplane instrument board provided with instruments for blind-flying. By the use of these instruments, the pilot can fly his ship safely in the densest fogs and soupiest weather.

ably would have flown to his icy death —at a lower altitude.

Now his knowledge of winds becomes important. Jones finds on the weather map windshift lines (line squalls), where cold air from the north meets warmer air blowing up from the south. When the two air masses meet, the warm air will be lifted violently.

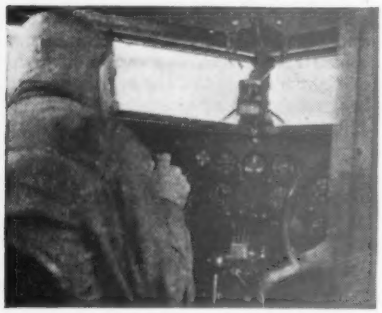
As it is lifted, it expands and is cooled by the expansion. It thus may



The air line pilot is receiving dope on weather conditions before his flight.

be cooled below its dew point, whereupon it will become filled with misty particles. Further cooling will produce rain drops, hail stones or snow flakes, depending upon the various meteorological factors involved. Windshift lines may be found on the weather map, but our lack of knowledge concerning the attendant phenomena is only further evidence that Jones and all of his kind must keep up with scientific research in order to continue their efficiency.

Meteorology, one of the oldest sciences, will lead us to new understanding of physical phenomena. For centuries observations have been taken, largely for the benefit of sailors and farmers. All sorts of climatic data have been gathered, but very often the



A view in the pilot's compartment of a modern transport plane. Note the instrument board.

prevalence of fog and its type have been omitted. Now aviators need a new type of meteorological observation, one that goes deeper—or higher—than frost and rain.

For years, the sailor's meteorology was considered good enough for the flyer but later experience has proved its inadequacy. Only during the last two or three years has the science of aeronautical meteorology really developed. The sailor is most interested in winds. Jones in the change of temperature with altitude, varying visibility and like phenomena high above the earth's surface.

Take this case. Jones reports via radio during a flight:

"Jones—plane Whitney—northbound —five miles southwest Sacramento— Seven thousand feet—lowering visibility to the north—closing in behind—cumulo nimbus clouds."

From his knowledge of meteorology, Jones knows he will find strong updrafts ahead and that he will be carried up into the thunder clouds unless he changes his course to avoid them. Therefore he flies off his course a couple of miles to avoid the clouds.

HAVING passed the clouds and resumed his course, with his rate of climb indicator at zero, he finds his air speed increases rapidly. Again his knowledge of instruments and meteorology tells him he is in a strong updraft. Simple correction follows.

Here's another case: A pilot leaves Burbank at midnight for Oakland, 375 miles north. He taxies out onto the field, tests his radio. He takes off. During the first broadcast he hears reported the possibility of thunderstorms ahead and he sees the sky is overcast. Across the Tehachapi mountains, a hundred miles ahead, Bakersfield reports good visibility. So he climbs.

He tunes for and finds the Saugus beam, heads for Saugus and soon finds the cone of silence over the Saugus station, hidden far below in the storm. Having passed the cone of silence, he sets his course for Bakersfield. Four times during this flight of about an hour he hears weather information broadcast from the Burbank station.

As he approaches Bakersfield, the pilot fails to see the lights of the town. On the fourth broadcast he learns the town is heavily overcast, a fact he already has determined for himself, closed in and with insufficient ceiling for him to come down through the clouds for a landing. Since there is no radio beacon on which he can land, he changes over to the Fresno beacon, passes up Bakersfield and flies on through the night. He reaches Fresno and lands in the moonlight.

You have only part of the picture up to this point. The pilot also has been watching his free air thermometer to make sure icing conditions have not developed, while reporting every 10 minutes his estimated position, arrived at on the basis of a combined calculation from dead reckoning and radio. Of course Bakersfield heard his engine, and he was able to check himself there.

Now he pulls out of Fresno and again must fly over clouds on the Fresno beam. After 50 minutes, the estimated required time for this run, he hears the "dash-dot-dash," indicating the letter "D," identification signal for the marker beacon. When this becomes clear

(*Concluded on page* 338)

This Boat is Provided with Water Planes

The inventor is adjusting the hydrofoils on his novel planing boat.

ALTHOUGH Dr. Oskar G. Tietjens, Swarthmore, Pa., has so far applied his new aquatic device only to motor boats, yet it undoubtedly will also prove of advantage to seaplanes and flying boats.

This device, which Dr. Tietjens calls a "hydrofoil," is a thin narrow steel airfoil section hoop that appears much like the full elliptic springs used on an automobile. When the boat is driven forward, this band acts like the lifting surface of an airplane and lifts the hull of the boat entirely out of the water. A lever extending through the bottom of the hull is for adjusting the angle of attack made by the steel lifting surface or "hyrofoil."

Recent tests made on the Delaware river showed a speed of 24 miles an hour when the boat was planing on the hydrofoil, this being more than twice the speed of the boat when propelled in the ordinary manner. It would seem that this arrangement could be applied to flying boats with advantage.

A Chute Storm

ONE hundred and fifty parachutes rained down from the sky over the Buffalo, N. Y., airport, and the sight attracted thousands of spectators.

But there wasn't a human being who enjoyed the float to earth, for each chute carried a 150-pound dummy. It was all a part of the regulation U. S. Army test arranged by the Irving Air Chute company which was making final arrangements to deliver the lifesavers to the army.

Lee Chase, pilot, took on load after load of the chutes, dropping them by a special trapdoor arrangement in his plane at five-minute intervals. Each chute was dropped twice, then repacked in the hangars and loaded with others on trucks for shipment to army air divisions.

Thus, an actual test of a parachute is worth a ton of theory. Testing every individual parachute with a dummy is the only safe way.

POP AV - 11/33

Testing Racing Planes

by JIMMY DOOLITTLE

A most interesting account of racing plane tests by one of the most noted racing pilots in the world. An address delivered by Mr. Doolittle before the *Institute of the Aeronautical Sciences.*

INASMUCH as my work for the past three years has been the developing and selling of petroleum products for aviation usage, I am scarcely in a position to deliver a truly up-to-date dissertation on scientific flight testing.

With your indulgence, I will, however, detail a few personal experiences encountered while testing and grooming a modern racing airplane. Since experimental high speed airplanes differ radically in certain phases of design, admitting numerous specific problems peculiar to each of several types; for the sake of brevity, I shall confine this discussion to the recent Laird 400 Racer.

In the mid-part of 1931, the ailerons and a good sized piece of right wing fluttered off my Travel Air "Mystery S" airplane which had just been rebuilt, cleaned up and obviously speeded up. This failure was probably due to the Frieze type ailerons being overbalanced at the higher speed or to flexibility in the aileron control tubes.

The failure of my own airplane made available the new racing plane that was built by Mr. E. M. Laird and financed by the Cleveland Speed Foundation. This little job had a 21 foot span, 108 square feet of wing area, carried 112½ gallons of gasoline, 8 gallons of oil and weighed 1,580 pounds when light and about 2,500 pounds fully loaded. (With the geared engine it weighed about 75 pounds more.)

The first test flight was made from the old Aero Club Field, south of the Chicago Municipal Airport. Laird felt or hoped that the high speed of the airplane would be around 300 m.p.h. The geared Pratt and Whitney Wasp Jr., originally mounted in the airplane, developed 560 h.p. at 2,500 r.p.m. The propeller was 9 feet in diameter and set at 37½ degree pitch at the 42 inch station. Due to the high pitch angle, the ground revs and static thrust were very low.

The airplane ran about a half a mile before it could be pulled into the air and then flew for about two miles more before it picked up sufficent speed to come under complete control. In succeeding flights, the propeller setting was reduced 5 degrees and the takeoff was satisfactory though the engine over-revved somewhat (2,600 r.p.m.) in level flight at full throttle.

THE tail surfaces were identical with those of the last year's racer. The airplane was stable longitudinally and laterally, but extremely unstable directionally. This directional instability increased with speed and the airplane was barely manageable at a speed of 200 m.p.h.

"Jimmy" Doolittle, then a U. S. Army pilot is shown with the U. S. Army racing plane that he flew in the last Schneider trophy race to be held in America. It was this race that brought Doolittle into public view.

This was due to the increased fin area forward, resulting from the longer N. A. C. A. cowl employed with the geared engine, the large pants and the fairing which filled in the space between the front and rear landing gear struts. All of this fin area was forward of the c. g.

The culpability of pants and fairing were proved by removing them and making a flight. The airplane was directionally stable with pants and fairing off. To correct the directional instability, the fin and rudder were increased in height nine inches. Thereafter the airplane was directionally stable, but not as stable laterally as before.

There did not appear to be any appreciable torque resulting from the large propeller and geared engine except an accelerational torque when the throttle was moved quickly.

Although the pilot was sitting on 50 pounds of lead shot, the airplane was so stable longitudinally that it was difficult to get the tail down in landing and the airplane landed very fast. The fast landing tendencies of this airplane were attributable largely to the fact that the tail could not be brought all the way down and advantage taken of the maximum angle of attack when landing, and also the blanketing effect of the large propeller disc on the small wings.

This is indicated by the fact that the airplane, when mounting the direct drive engine and 8 foot propeller, was only slightly lighter but was less stable and landed considerably slower; I should say fully five miles per hour.

In order to ventilate the pilot's cockpit, fresh air was led through a flexible conduit from two holes located in the leading edge of the upper wing. These holes were about three feet from the center line of the wing, located in the slip stream, but well outside the "fume area."

The center of each of these circular holes was somewhat above the center-line of the leading edge and the tops of the holes were aft of the bottoms. In flight the starboard hole blew slightly and the port hole sucked slightly. The efficiency of the ventilating system increased somewhat as the speed increased. The trouble was corrected by putting a scoop on the top of each hole.

The geared engine ran much cooler than the direct-drive. The head temperature averaged from 50 to 75 degrees lower. This appeared to be due to two things. First: The nose of the N. A. C. A. cowl on the geared engine was longer and tended to direct the air over the cylinder heads better than the blunt nosed N. A. C. A. on the direct-drive engine. Second: The geared engine was throwing more oil than the direct-drive engine. This was

indicated by greater oil consumption and higher oil temperature in the use of the geared engine.

At a later date, the direct-drive engine was returned to the factory. The bearing clearances were increased so it would "sling" more oil and overheating difficulties were eliminated. The oil consumption was increased from about one quart to three quarts per hour. This increased oil consumption, however, was not a problem as there was ample oil tankage. Using the oil for a cooling medium caused the oil temperature to run too high and it was necessary to cool the oil by directing cold air taken from in front of the engine and over the oil tank.

The fuel used was a straight-run gasoline containing 3 cc's of tetraethyl lead and having a knock rating of 87 octane. For full throttle operation, an 89 octane gasoline, containing 5 cc's of lead was used. This was a safety measure with the 6:1, 10:1 Wasp Jr. as the 87 octane fuel operated satisfactorily.

The 87 octane fuel was probably on the border line as I later flew a 6:1, 12:1 Wasp Sr. and with this engine at full throttle operation, the 87 octane fuel started detonating almost at once and the thermocouple showed a head temperature of over 600° F. With the 89 octane fuel there was no detonation and head temperature was steady at about 520° F. The 87 octane fuel was satisfactory at cruising speed.

THE 400 Racer was extremely temperamental to rig. It seemed impossible to adjust the landing and flying wires so that it would not be wing heavy on one side or the other. On one flight it balanced perfectly for a while and then gradually became left wing heavy.

Finally, in desperation, the stick was slapped over hard to lift the left wing and the wing heaviness after leveling off was greatly increased. This gave me an idea. The right wing was depressed and the stick moved sharply to the left. The airplane was then only slightly left wing heavy. The maneuver was repeated and the airplane balanced perfectly. Repeated again and actual right wing heaviness resulted. Here was an airplane that could be rigged in flight!

The difficulty was that it wouldn't hold its rig. This fault became continually and rapidly more apparent and annoying. On one flight, in very rough air, the rigging became so flabby that an actual lateral motion of the trailing edge of the upper wing could be observed when the ailerons were moved and when a bump hit one wing more severely than the other.

Before the flight was completed, it was found impossible to get the airplane out of the left bank at cruising speed without throttling back; so all turns, even around the landing field,

(*Continued on page* 338)

The Canadian Sky-Cops Patrol Great Areas

Members of the Ontario Provincial Air Service who have dropped down to refuel and swap a few yarns in their leisure moments.

THE accompanying photo shows two "Sky Cops," members of the Ontario Provincial Air Service, who have just dropped down on the Moose River near James Bay at a gas cache on the northernmost boundary of their "beat," to refuel and grab a quiet smoke.

Northern Ontario provides very tricky flying country for seaplanes—and is an utter impossibility for landplanes. Tangled scrub, jagged lava rocks and mile upon mile of heavy forest are some of the hazards.

Plenty of lakes dot the terrain and rivers snake through it, but the pilot must constantly watch his altitude and keep an eye on the proximity of the nearest water. Landings have to be made carefully, for lakes and rivers are infested with "deadheads" or partly submerged logs, the enemies of seaplane floats.

In spite of these handicaps, however, the Ontario Provincial Air Service has gone quietly and efficiently about its work, covering its gigantic beat with a very small percentage of accidents; three serious crackups in the past five years.

Fire spotting, transportation of men and fire-fighting apparatus, photography and game preservation are their chief duties. Up until a few years ago, game preservation did not come under the jurisdiction of the Ontario Provincial Air Service, but it was found to be the most effective means of combatting the canny bushwise fur poachers who invade the Provincial Parks in large numbers every winter. The Flying Wardens swoop down out of a cloudy sky and catch the poacher redhanded.

De Haviland Moths, as pictured, and HS2L flying boats are the types of ships used for this work.

L. A. A. Memberships Grows Slowly but Surely

SLOWLY but steadily, the enrollment of the L. A. A. continues to increase. During the last month, the daily average is about the same so that this gives us renewed confidence in the outcome.

It has taken a lot of plugging, both by our committee-men and ourselves, to make it move along. At the time we go to press with this issue, the total membership is 352 so that we have only 148 members to go.

Here in Illinois, the Governor of the state has revived the aeronautic commission after it was once killed. Landis is no longer on the Illinois Aeronautic Commission, but the board is filled with an altogether different staff that may deal more leniently with the amateur.

We are putting our trust in one of the members who has proved his valor and squareness in the past, Commander Eugene MacDonald, president of the Zenith Radio Corporation and at one time the mainstay of the radio amateur. If he should have his way, there is no doubt but what the amateur in aviation would also get a break.

We have also had very favorable news from the Texas legislature on the subject of amateur aviation laws so that things look bright in that state. Altogether, there are about eight safe and sane states where freedom really reigns. If given the assistance of all the amateurs, it is likely that we can make this a total of 48 states. Let's try and do this, anyway.

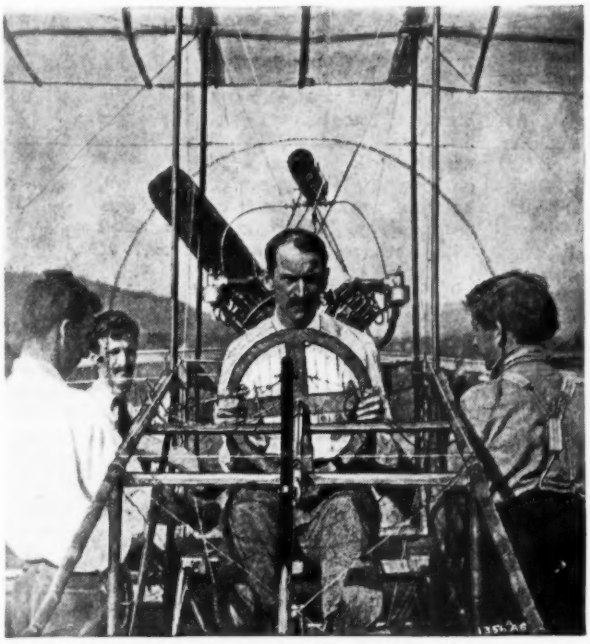
Early Days With Glenn Curtiss

by C. H. QUINN

A story of the pioneer days at Lake Keuka and the various activities that led up to the experiments that made Glenn Curtiss famous in the history of aviation.

MY INTEREST in Glenn Curtiss was of the most ordinary sort when I first began dropping into Barney's lunch room in Printing House Row. Then, one day, a casual remark I happened to drop about the settlement of the big Curtiss estate opened up a mine of interesting information behind the counter over which Barney dispensed good coffee and fried cakes.

When our first conversation opened in the most natural manner, I had not the faintest idea that I was talking to a man who had worked for years with the great inventor in his little shop in Hammondsport, N. Y. And the stories of the great aviator-inventor that afterwards drifted piecemeal over the counter with the pleasant odor of cooking food, were ripened by years of thought and reflection in the storehouse of excellent memory possessed by Barney.



Glenn Curtiss seated at the wheel of the "June Bug," one of the first successful airplanes built by The Aerial Experiment Association. This historical old ship was among the first of the airplanes that actually flew.

Because he had worked with Glenn Curtiss long before the latter began his first experiments on airplane construction, Barney was present at the birth of the great idea. It seems from all the facts in the case, it is most probable that Curtiss himself did not know just when he made his first discovery of principles which afterward enabled him to develop his airplane invention. He was constantly experimenting in his little bicycle shop.

Long before his mind turned to aviation, Curtiss developed the motorcycle which proved to be a step toward creation of his airplane. One idea led to another as experiment followed experiment. The two men, Curtiss and Barney, often worked till the small hours of the morning perfecting some part of the motorcycle engine which was one of the early efforts of the inventor.

"Glenn had one of the first bicycles that came out with a small gasoline engine on it as a helper," said Barney, telling of this early stage of the inventor's work. "He had it in the window of his store and bicycle shop there in Hammondsport, more as an advertisement than anything else. He had it jacked up and running and of course it attracted a lot of attention because gasoline engines were not common then.

"Watching that little engine started Glenn to thinking. The engine was very small and only intended to help propel a bicycle, merely to make bicycling easier. One day Glenn said to me: 'If those little cylinders give that much power why won't bigger ones make a lot more?' So he went to work to make an engine big enough to carry the whole load. After it was done and attached to a bicycle the first tests proved that the ordinary bicycle frame was not strong enough to withstand the vibration. The engine quickly tore an ordinary bicycle to pieces.

"Then he faced the problem of getting larger and stronger steel tubing. That was not easy. Glenn searched the entire shop for stronger tubing but couldn't find any. Then one day he walked over to the show-window where there was a tandem bicycle on display. It was a new one worth around a hundred dollars and had the kind of tubing that Curtiss wanted, so out it came into the shop and it was not long before he had it all apart and the tubing sawed up in the longest possible pieces."

Then Curtiss began building an engine that he figured would be big enough to run a motorcycle and carry a heavy man up grades. Back and forth from the bicycle shop to the village machine shop the two workers plodded hundreds of times to get each piece of the engine machined to the desired point.

But the engine did run and it did some other things too. It made noise and how! One of its achievements was to alienate most of the neighborly feeling for Curtiss which is supposed to make life in a small village superior to that in a big city. Sleep at night, when experiments with the new engine were going on, was enjoyed only by residents far from the scene of the Curtiss developments. And they were developments.

The great motorcycle, which later proved to be a step toward the Curtiss biplane, was set up in the shop on blocks and when tests were made it required a man on each side of the thing to hold it down. It would jump a foot into the air with each explosion. Conversation could be carried on only by shouting and hand signals.

"When the day for the first road trial came," continued Barney, "we had the bike blocked up in a barn near the store. Curtiss filled the gasoline tank—which did not hold much. Of course, he had no carbureter, just a mixing valve as we called it then, a simple device that mixed air and gasoline. With the first explosions, the motorcycle jumped like a wild colt and it took the strength of another man and myself to hold it till Curtiss jumped on and grabbed the handles. The vibration was terrific and his voice could hardly be heard above the din.

"'Pull the blocks and let her go,' shouted Curtiss and I did. With an ungodly racket the machine tore out of the barn and into the street. The other man and myself jumped on bicyles and followed. Curtiss steered the machine for the edge of the village. Then the importance of one thing that he had left off the machine impressed itself on Curtiss. There was no way to stop the machine!"

So engrossed had the inventor be-

come in getting the machine to run that he had omitted putting on something to shut it off! There was no such thing as a switch on it, and no way to shut off the gasoline flow to the cylinders, so it just had to run till it ran out of gasoline—or something happened.

Curtiss jumped off and the motorcycle ran into a ditch and stopped.

"I could make forty miles an hour on a level road," declared Curtiss after the experiment. This event had far-reaching results in the brain of the young inventor and he was soon launched on experiments with his "wind-wagon," the fore-runner of the biplane.

The wind-wagon was a three-cornered affair, a sort of platform with two motorcycle wheels on the broad rear part and one on the front point. A single shaft at the rear formed an axle for the two rear wheels. On the platform, between the two wheels, Curtiss placed a motorcycle engine of about four horsepower. To the engine was attached a stub shaft that stuck out at the rear and on the stub, Curtiss fastened a wooden propeller.

"Glenn's experiment with his wind wagon with the engine on the back end produced a real sensation in the village," said Barney. "It also threw great clouds of dust when he rode it through the streets. The few residents who had remained his friends up to this time began to desert him as the wind wagon passed from one stage of development into another. After trials with one four-horse engine, Glenn found he did not have as much power as he desired, so he put another four-horse motorcycles engine on tandem fashion.

"That gave him better than eight-horsepower for the three-cornered wind wagon. It also gave him much greater power to stir up road dust and anything else lying dry and loose in the street. Of course, nearly everyone drove horses then and the streets were not paved, swept nor sprinkled. When Curtiss drove his double-engined wind wagon down the street he swept it pretty clean of everything and you can imagine what landed in the yards and houses that he passed.

"Long before this time, Curtiss had exhausted all his money in experiments and all that he could borrow from friends and relatives. So when he got the wind-wagon to working he had no money and darn few friends. He did, however, get some money from making small gasoline engines that he advertised.

"One day I went into the shop in the barn and found Glenn had a big thing built across the pointed front of the wind wagon. It was a square frame on hinges. With a system of levers, he could work the back of the frame up and down. This frame was covered with cloth and was a crude sort of wing.

"What's that thing for?" I asked Glenn.

" 'Oh that's to ease me over the thank-ye-marms'," he said.

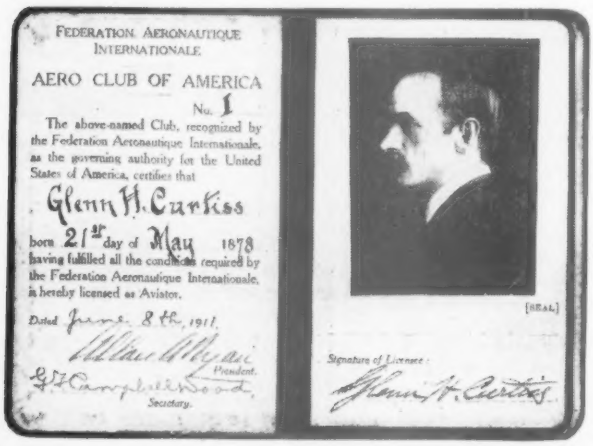
"One thing that his wind-wagon taught him was he should put his engines at the front instead of the rear. When he would strike a bump the front end would fly up in the air. It is a wonder that he was not killed in those experiments with that crazy thing, it certainly was dangerous.

Well, he found that his flapper across the front of the wind wagon did help to ease him over the bumps in the road, for by pulling his lever and tilting the frame with the cloth on it he could partially lift the front of the machine off the ground.

"But money did not change him like it does a lot of people," and this is the part of Barney's memory of the great aviator which he cherishes most. "He wanted to help every man who had worked with him in his hard luck days and he never got so swelled up with fame and money that he forgot them.

"After I had left him and went into the restaurant business, Glenn came to me and wanted me to come back and work for him. He made me a tempting offer and maybe I made a mistake in not taking him up. It showed his democratic spirit and disposition to appreciate old friends."

Volumes more Barney can tell of the early days of Curtiss' struggles in the little shop, but workers in the Printing House Row can't take time all in one lunch hour to get them all.


FEDERATION AERONAUTIQUE INTERNATIONALE

AERO CLUB OF AMERICA

No. 1

The above-named Club, recognized by the Federation Aeronautique Internationale, as the governing authority for the United States of America, certifies that

Glenn H. Curtiss

born 21st day of May 1878

having fulfilled all the conditions required by the Federation Aeronautique Internationale, is hereby licensed as Aviator.

Dated June 8th, 1911.

President.

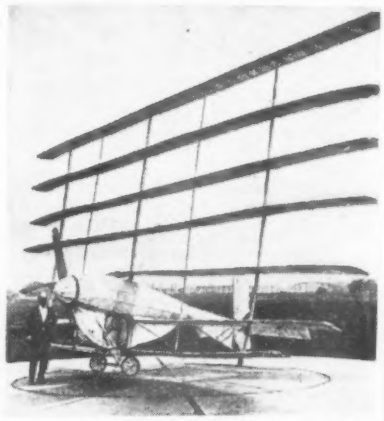
Secretary.

[SEAL]

Signature of Licensee: Glenn H. Curtiss

License No. 1, the first F. A. I. license to be granted, was issued to Glenn Curtiss in 1911. This was an acknowledgement of his leadership in the early days of aviation.

An Early Foot-power Plane



The elaborate pedal driven multiplane built by W. F. Gerhardt, Dayton, Ohio.

ALONG in the 1920's, a lot of work was being done by the foot—pedalist school of thought—experimenters who firmly believed that man himself could provide sufficient power, via his feet, for soaring through the air.

Among those who partly succeeded was W. F. Gerhardt, an aeronautical engineer at McCook Field, Dayton, Ohio, who is shown standing beside his "septiplane" if that is what you call a seven wing ship. His name for it was "Cycloplane," although this is rather misleading in many respects. Mr. Gerhardt, who made a short hop, claims to have been the first man to rise an appreciable distance from the ground in a muscularly propelled machine.

Every attempt, then known, was made to conserve power. The fuselage was well streamlined and the planes had a truly enormous aspect ratio and a large gap chord ratio. This flight took place on July 22, 1923, the power amounting to about one-eighth horsepower. It is claimed that Mr. Gerhardt went into active training for the event.

Colored Men Cross Continent

CALFRED ANDERSON, licensed transport pilot and Dr. Albert E. Forsythe, licensed private pilot, both colored, made the first round-trip transcontinental flight to be made by members of the colored race.

It is noteworthy that this flight was made in a lightplane, a Fairchild "24" two-place cabin monoplane, provided with a 95 h.p. Cirrus engine. In spite of the fact that the plane was equipped only with a minimum number of instruments, the pair flew through fog and clouds very successfully. The total flying time was 67 hours which is excellent time considering the equipment and the delay experienced in Nebraska by storms and adverse winds. The venture was backed by prominent members of the colored race.

Aerial Press Photography

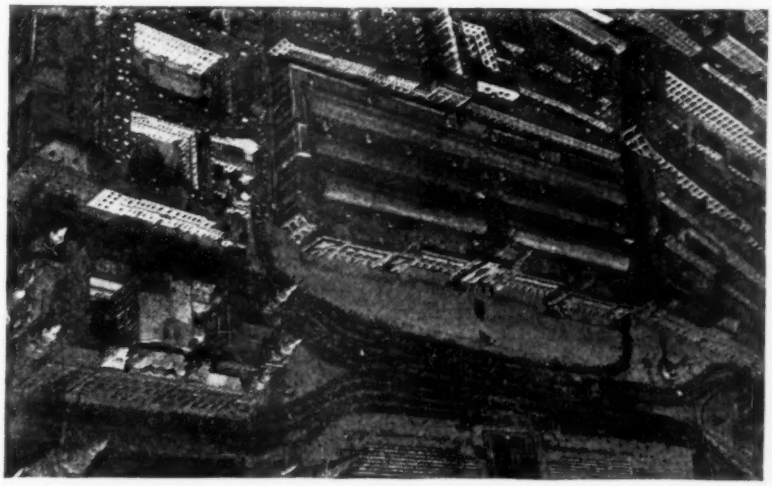
The airplane plays an important part in the collection of the day's news and in the production of newsreel motion pictures. Again, the airplane camera generally gives a more comprehensive view of an event than a ground camera.

THE years 1928 and 1929 will stand in aeronautical history as the years of transition from war time conceptions of aerial photography to its acceptance as an instrument of commerce. Prior to the World War it was not even a potential peace factor and in the early stages of the war was not an outstanding participant, although photographs of military movements along the front and observation possibilities began to appear after the first six months of 1914.

Ships of all sorts were rapidly being constructed abroad in 1928-1929 for use as commercial transports and carriers for photographic surveys. The manufacture of more suitable cameras and lenses for geographic surveying and map making at this time also made it possible to introduce this medium of photography to the business world. But, though it has now established itself to the point of being a definite utility, there is still much to be accomplished.

It was a young surveyor who, after a flight in an aerial photographic machine, and witnessing taking of a few oblique photographs from an airplane in Canada, hit upon the idea of surveying and mapping Ontario by a system of overlapping oblique photographs on the grid system from which the maps were afterwards plotted.

Thus, Canada today is being mapped twenty times faster than it has ever been done before by means of aerial photography and a hundred times more accurately; so accurately in fact that all of the original survey maps of Ontario had to be scrapped. The air survey maps have proved the old surveys to be exceedingly inaccurate.



Airplane camera view of a news event, the celebration of Lenin day in Leningrad, Russia. This view would have been impossible with any other camera.

A great railway engineer said a little while ago that in many parts of the world, where he had constructed railways over poorly surveyed territory, that those railways would have cost far less to construct had he in his day been able to avail himself of the use of air survey. Air survey is undoubtedly of greater importance to the U. S. than almost any country in the world. The opening up and development of territories within the continent, such as Alaska, etc., can now be carried on at a far greater rate than was ever dreamed of in the past by the air survey method.

The first practical camera operations were undertaken with ordinary types of ground cameras, mostly of the "Press" variety, but by the end of 1915 cameras designed expressly for aerial work were put into production. Lieut.-Colonel J. T. C. Moore Brabazon, M. C., who was later chief of the Photographic section of the Royal Air Force, designed and produced—in conjunction with Messrs. Thornton Pickard, Ltd.—the first practical camera for aerial operations. This was later improved upon.

Aerial photography differs from most branches of photography, because the distance between the camera and the object being photographed is very great. Between the lens and the subject there exists a great depth of air which reflects light directly back into the lens producing haze. In photographing mountains, Zepplins, or other objects at high altitudes, haze frequently causes trouble.

In no branch of photography, however, is haze so important as in photography from the air. Owing to a large proportion of active light reflected by haze, its effect is much greater photographically than visually, often being serious in photographs taken under visually clear conditions. At altitudes of 10,000 feet or more the haze effect is frequently so marked that it becomes difficult to distinguish detail in the photograph.

The photographic airplane should be a "pusher," or a twin engine type without an engine in the nose of the fuselage. The pilot can only fly really accurately with a clear view ahead. Twin engines are most desirable, because air surveys usually have to be carried out in country difficult of access and there-

The airplane camera lends itself particularly well to the photographing of cities and for publicity work in connection with city developments.

fore usually dangerous in case of forced landings.

THE airplane has been found to be a great asset to the journalistic world in conjunction with aerial photography.

Transportation is an ever-present problem of the press and every improvement in the means of transportation has brought about a marked advance in the efficiency and comfort of the newspapers. In the last century the existence of wireless, locomotives and automobiles has played a great part in the gathering and distribution of news events, but at the present time the new means of transportation—the airplane—is taking its place beside the automobile and the locomotive as a factor in the rise and fall of present circulations.

America offers every possible facility for practical demonstration of the manifold use of aerial photography. With business men experimentally inclined this country has given such undertakings as the Fairchild Aerial Survey, Inc., and Hamilton Maxwell, Inc., both of New York, opportunities of which they have certainly not been slow to take advantage. The American pioneers are by no means behind the world in technical knowledge and equipment for we have carried the practical side of our operations to a stage that would surprise many Europeans.

The Fairchild Aerial Corp., have recently completed a survey of New York City with considerable success. It has enabled the planning of a new overhead rail route through the city. With detailed views of roofs, scuttle holes and skylights, it has assisted the Police Chief in raids; and has recorded how groups of traffic can proceed for a given period of time with the least interference.

Then, there is the case of the old frigate, "Granite State," which burned to the water and sank at her dock at 98th Street and North River. The origin of the fire was a mystery until officials, scanning the aerial photographs made of the fire by the Press and immediately preceding it, discovered the presence of a substance floating on the surface of the water at that part of the waterfront. This proved to be oil. An investigation resulted in tracing the oil to a broken line on the river bottom.

However, before I endeavor to tell you of the experiences which confront many a cameraman assigned by the various newspapers in the field of aerial photography, permit me to explain the functions of the Daily Press whereby you will have a clearer understanding of the life of the Aerial Cameraman and his experiences.

Getting the news "story" is always started by an assignment from the City Editor or the Editor of any department who has charge of specified events such as theatrical, sports, society, aviation, etc. The reporter then succeeds in getting the story through various channels which, if I would try to explain, would take a volume.

However, after the reporter has obtained the facts of the story, he reports them in writing to the copy-reader. In cases where time is very limited, the reporter calls his office by phone and is connected with a rewrite man who immediately converts it into a bulletin or story. In the other case, the copy-reader upon receipt of a story, corrects it for proper placement of words, punctuation and other corrections besides editing the story. The City Editor must approve the story for publication before it is sent to the composing room.

At a given time, which is commonly called the "dead line," all stories must

Aero-newsreel photo of a hit made during Navy target practice.

be in the copy-desk for the next edition of the newspaper. At certain hours during the day new editions are printed which consist of late events, including the important stories of the previous edition. The last edition, called the "final," consists of all events which have occurred during the past twenty-four hours.

The functions or duties of the staff cameraman are similiar to those of the reporter. The process of making photos for newspapers takes a little longer than story composing and printing. The photo is sent to the engraving department where a cut is made before it is sent to the composing room for proper placement of the page of the newspaper.

In the past, a bird's-eye view of an event, photographed from a roof or high level, was considered as a specialty. For the past few years, Editors have found it to be greatly convincing as far as the public was concerned. Details can be better outlined in this type of photographs. Today, almost every newspaper either has its own airplane equipped with an aerial camera for such observations, or else airplanes are chartered with the necessary equipment for a particular purpose.

The cameraman assigned to such a plane has many obstacles before him which usually hinder the carrying out of his duties. These consist of time, weather, atmospheric conditions and the ability of the pilot in maneuvering the ship into a proper position for taking the photographs from necessary angles.

The cameraman who is assigned as an aerial photographer for a newspaper or motion picture newsreel must understand that his services are at the disposal of the paper at all hours of the day and in all kinds of weather. Not only do cameramen subject themselves to danger in the performance of their duties, but in one case which I must relate to you, an assignment Editor and one of my superiors accomplished a feat of great daring.

During November, 1927, Mr. McKean, Assignment Editor of Paramount News, offered his services for an errand of call for Paramount News, which was then in its infancy. Incidentally, this peculiar assignment called for the quick delivery of films containing pictures of the 10th Anniversary of the American Legion Convention held in Paris, France, November 11, 1927, and also, the celebration of the signing of the Armistice. Arrangements were made by cable with one of our foreign correspondents and the cameraman, stationed in Paris, sailed on the Leviathan on the same day with the developed negatives of the occasion, including three positive prints of these negatives.

These films were to be placed in a white airtight container and dropped from the ocean liner into the sea at 400 miles outside of Nantucket Light where a seaplane, carrying Mr. McKean, would pick up these precious pictures. Then with the aid of a capable pilot, (who I believe was Bert Acosta, the famed transatlantic flier) they would fly these films back to New York for showing in the Broadway theatres the same evening.

Arrangements were concluded when the Captain of the Leviathan and the officials of the Steamship Company agreed to stop the liner for a few minutes at the appointed place of transfer. The scheduled time for the liner to reach this location at sea was set for 4 P. M. on Sunday, and the liner was to dock in New York the following Monday morning.

If these films were not picked up by plane Sunday afternoon, then the competing newsreels would also have their films at the theatre on Monday evening. Therefore, you see how essential it was to obtain the advantage of this opportunity in transferring Paramount News films and thus enable the showing of this event 24 hours before the other newsreels could offer the same films.

(*Concluded on page* 334)

Measurements of Speed Are Uncertain

AS WE have frequently remarked in these columns, the estimation of speed in the vicinity of 400 m.p.h. is a difficult and sometimes uncertain matter. For this reason, press announcements of a record speed given directly after the run or contest are open to question in most cases and should be taken with the proverbial grain of salt.

There are a great many things to consider in giving the absolute value of speed, not the least of which are instrumental errors or errors of observation. This is true even with the most modern of electrical and cinematograph timing devices at very high speeds where a slight lag of a small fraction of a second means a whole lot in the final analysis.

This is rather proved by the results published directly after the Schneider Trophy race as compared with the results finally arrived at after prolonged consideration. As will be seen from the following table, there is a considerable difference between the speeds announced to the press on September 30, 1931, directly after the race and the figures finally submitted to the Federation Aeronautique International at a later date.

	Estimate of Sept. 30	*Revised Speeds*
First run	415.2 m.p.h.	Ruled out
Second run	405.1 m.p.h.	407.4 m.p.h.
Third run	409.5 m.p.h.	409.5 m.p.h.
Fourth run	405.4 m.p.h.	407.6 m.p.h.
Fifth run	x x x x x	404.5 m.p.h.
Average	408.8 m.p.h.	407.5 m.p.h.

The first run was eliminated because of the fact that Stainforth's approach to the course was open to question and in the revision, the fifth run which was made to guard against any question that might arise, was used instead. The speeds were made by recordings on a motion picture film.

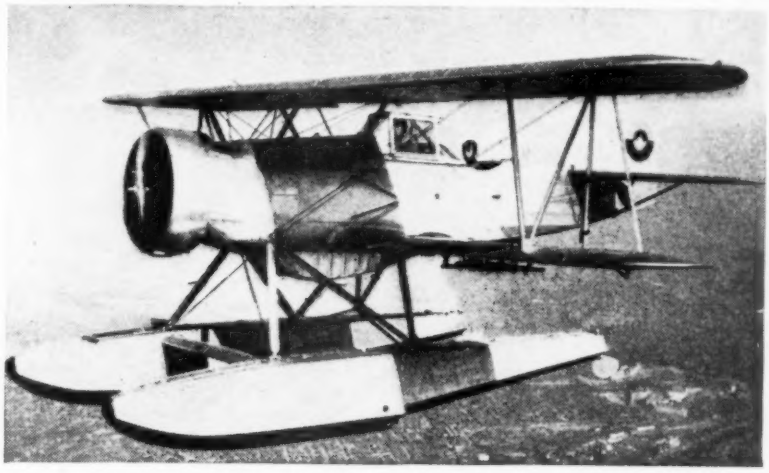
This is One Woman's View

"I HATE to say it", remarked Miss Margery Doig, department store buyer of New York City, who flies her own plane Sundays and holidays for recreation, "but women aren't really as good as the men in flying. They just aren't, that's all."

Women fliers, especially in the eastern United States, are poor sports, publicity seekers, catty to each other and inferior to men in all departments of aviation, asserts Miss Doig. She has met and flown with the nation's leading aviators, both men and women, and these are her conclusions.

EDITOR'S NOTE! *This statement by Miss Doig is quoted here because it has been widely circulated, but if the reader will check up upon the recent activities of women flyers, he will be convinced of the error in these remarks.*

Increased Aerial Activity in Colombia



This is one of the Curtiss Falcons now in the service of the Colombian Government military forces.

THERE has been a marked trend toward increased aeronautical development for some time in the South American republics and more particularly in Colombia, S. A., where great advances are being made in both military and commercial flying.

While not generally known in the United States, the SCADTA airlines are the oldest in the Western hemisphere, being organized in 1919 for scheduled commercial operation in Colombia. Last year, the SCADTA planes flew 625,320 miles, carried 7,906 passengers and 2,000,044 pounds of cargo. Even more remarkable is the fact that this line maintains flying schedules over certain of its trans-Andean routes at altitudes of more than 12,000 feet.

Aviation has thrived and is superseding other forms of transportation largely for the reason of the difficulties offered to railroads by this Republic's extremely mountainous terrain.

A number of American built planes are employed by the Colombian government for military and observation purposes. This service covers a tremendous territory, equal to the combined areas of France, Germany, Austria and Belgium. A number of Curtiss Falcons are employed for observation purposes.

A New Development in Lubrication of Engines

INVESTIGATION of a revolutionary lubricating fluid used in pre-conditioning the motor of an automobile driven 745 miles without oil, discloses that its chief ingredient is a highly lubricative colloidal (gel-like) substance, so finely subdivided that a volume the size of a pea would cover a mile surface with a thin self-lubricating film.

This startling statement was made by Dr. G. A. Abbott, head of the chemistry department of the University of North Dakota, who is a nationally recognized authority on oils. The fluid was also used in pre-conditioning the engine of an airplane recently flown for 35 minutes at Winona, Minn., after all oil had been drained from its crankcase.

"The minute colloidal particles, when introduced into a motor by adding the carrier fluid to the regular crankcase oil, are apparently attracted to the surfaces of the pistons and cylinders, forming a very thin but smooth and uniform film that thoroughly fills the finest pores and crevasses of the metal, preventing the rubbing of iron on iron," Dr. Abbott said.

"As this lubricating coat wears away it is continually renewed by fresh deposits of the colloidal particles suspended in the oil stream. It is very probable that the fluid contains some stabilizing agent in small quantity to prevent settling. The particles readily pass through the finest filters.

Thus, when a motor thoroughly conditioned with this colloidal substance is run after all oil has been drained from it, the film established upon the surface of the metal will serve as a lubricant until its thin layer wears away. When it disappears there is left a mottled surface exposing both this highly lubricative substance and iron, for the cavities of the metal are still filled with sub-microscopic colloidal particles.

As the mottled surface is ground down, these particles are smeared over the protruding metal spots, which strongly attract and hold them. In this way a continuous film of lubrication is maintained until the metal is worn down to the limit of penetration of the particles into its pores. This is somewhat in conformity with Southwell's views on lubrication theory.

Jimmie Wedell — Speed King

Jimmie Wedell takes a moment from his manifold duties.

JIMMIE "BUSY" WEDELL is not only kept busy grooming his hangar of racing planes; he is also chief of the Wedell-Williams Airline of Louisiana. In this latter capacity Jimmie has just completed a course in blind flying at the Fort Worth, Texas, Municipal Airport.

"This blind flying stuff isn't so new to me," Jimmie explained, "as I have found it necessary to do a considerable amount of it while making transcontinental flights." When Wedell recently broke the world's record flight mark from Mexico to Ottawa, Canada, he flew several thousand miles with no sign of terra firma.

Wedell's sense of balance and direction, that has so often stood him in good stead as a speed merchant, was obtained while riding a Texas cow pony. "Little Joe the Wrangler" is still his favorite song and he sometimes sings snatches of this ditty when riding herd on a Wedell-Williams airliner.

"Although I've spent a considerable portion of my days in riding tough broncs and some hay-wire crates I still draw the line at autogiros and blimps. Old fashioned, I guess," Wedell declared.

The writer, however, doubts this latter statement. He chanced to see Wedell streak down the straightaways at the Chicago races at a 305 mile an hour gait to take first place.

Swamp Flyers

THE international air lines are being bothered by stowaways—not human, but mosquito. The United States Public Health Service has discovered that carriers of fever from the tropics can be imported in this way, and now all planes coming into the country from the tropics are being fumigated regularly.

Our Photo Phans Column Reopens for Business

WHEN the weather gets bad and the air is chilly, there is renewed activity in photo collecting, hence the reopening of our Photo Phanatics Club that was so popular last year.

During the past few months we have had so many requests from former members of our club, for starting this feature, that we have decided to continue it as before. And to soothe the feelings of some of the Super-Phanatics, we intend to run the photo swap notices in this department instead of in the Barter and Exchange section where they have been reposing for some time.

The "mystery ship," run in the September issue, brought in a host of replies which proved that our eagle-eyed membership is still on the job. Yes, fellows, this picture was a side view of the venerable old Standard J-1, used largely in France during the war as a general utility vehicle. After the war, they participated in barnstorming with the old Jennies in this country and a few of them are still in action according to dope received from various parts of the country.

Strange how this wartime stuff still proves to be an attraction, but it does. There seems to be a glamor of romance about these old crates that proves irresistible to many of our photo collectors. The fact that there is not such a demand for the pre-war ships, that are truly historical, leads us to believe that interest in the Spads and Camels is based rather upon romance than historical interest.

While we hate to pull any statistics on you, yet we have made a little survey from our correspondence that indicates the relative popularity of various sorts of airplane photos.

PHOTO PREFERENCES

Class	Percent.
Old wartime planes	48
Modern Military planes	27
Racers and stunters	15
Commercial transports	8
Old-time pre-war planes	2

You see, the wartime planes win out by a large margin while the old-timers come last. To tell you the truth, we are mighty glad that it is this way for it is a lot easier to get wartime photos for the magazine than any of the old-timers. And we like easy jobs best.

Strange to say, there has been little demand for dirigible or balloon pictures, but as we have a fine collection of old-time balloons, dating 'way back when, we are anxious to run them. There are pictures of the first Montgolfiers, early aeronauts and all the rest of them. What do you say on the balloon subject, just for a novelty?

Relative Costs of Transportation by Various Vehicles

(Courtesy of the Society of Automotive Engineers)

IN A paper read before the International Automotive Congress of the Society of Engineers, Chicago, J. C. Hunsaker set forth many interesting facts concerning the airship when considered as a commercial carrier.

Mr. Hunsaker, vice-president of the Goodyear-Zeppelin Corps., is one of the accepted authorities on the subject of aeronautical engineering and his tabulation of comparative operating costs of various commercial vehicles is very illuminative.

These generalizations stand out:—For freight, in which time is not vital, neither the airplane nor the the airship is economical. Over routes suited to their use, the airplane and airship have comparable unit costs. The airplane costs per passenger-mile are to be compared with those of the crack trains, and the airship costs per passenger-mile, with the first-class liner.

Actually, neither the airplane nor the airship will attain such favorable results as those shown on the table because of insufficient volume of traffic.

COMPARATIVE TRANSPORTATION COSTS

	Av. Speed (m.p.h.)	Range Without refueling (miles)	Full Passenger Load	Cost per Passenger mile	Cost per Ton Mile
High Speed Airplane Transport	165	500	10	8c	80c
Low Speed Airplane Transport	110	600	15	6c	67c
Rigid Airship (Dirigible) (4 Ships)	75	4,000	80	13c	25c
MARINE TRANSPORTATION					
DeLuxe Liner	30	4,000	400	10c (First Class)	
Cabin Liner	20	4,000	600	6c (Cabin Class)	
Cargo Steamer	15	4,000			1/5c
RAILROADS					
High Speed Rail Cars	80		70	2c	
DeLuxe Trains	50		150	5c	
Freight Trains	25				1 1/5c
MOTOR VEHICLES					
Automobile	40		5	1c	
Motor Bus	35		25	1½c	
Motor Truck	25				5c

NOTE:—*Passenger airplanes and airships are assumed loaded with freight equal to weight of passengers and their accommodations and mail load.*

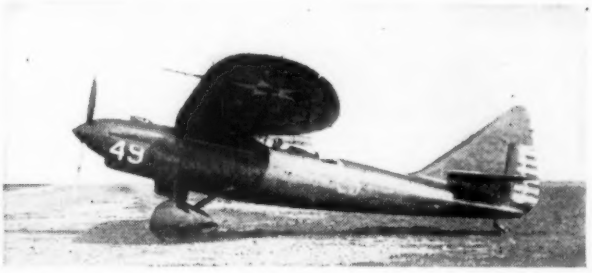
Late Army Air Corps Planes

Eight examples of ships now actively in the service of the U. S. Army Air Corps. These are representative of ships designed for various military purposes.

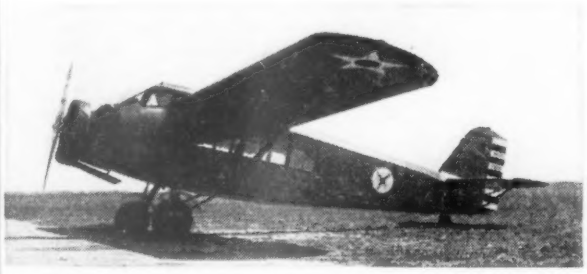
This is the Fokker YO-27 bi-motor tractor monoplane with the engines faired into the wings.

The new B9-7 Consolidated Basic Trainer is an interesting development in coaching ships.

The Douglas YO-31-b, a two place tractor monoplane of rather slender sweeping lines.

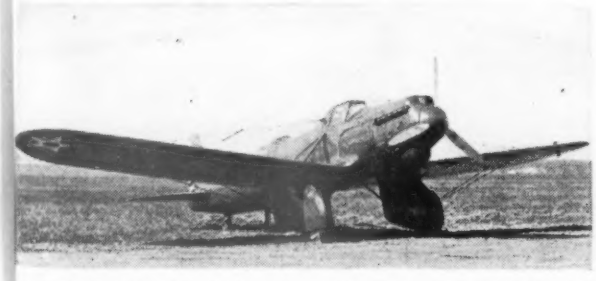


The Douglas YO-35 is a gull-wing monoplane job with the pilot's pit well to the front.



This is a Fairchild Army Transport of the conventional Fairchild design.

Douglas O-2H now being tested at the Air Corps Advanced Flying School for Observation training.



The Curtiss YA-8 Attack plane, a recent development of the Curtiss A-8.

The new Consolidated PT-11 Primary Trainer is a sturdy yet neat looking airplane.

The Evolution of the Wing —

by

ALVIN EDWARD MOORE

Associated with the U. S. Patent office and authority on aeronautic inventions and patents.

A monoplane equipped with wing slots at the leading edges of the wings and flaps at the trailing edges, the latter shown depressed for steep climb or low speed.

I RECENTLY traveled 3,500 miles by motor car in seven days. At times, I imagine I still feel the swaying of the car at high speeds, the sudden application of the brakes and the breath-taking skid of wheels over ice-sheeted roads.

In my mind's eye, I still see the wrecked cars by the wayside, the sheep that had been run over, the wounded cow that had met the next car ahead in a head-on collision and the poor man in overalls that lay stretched out by the side of the road, killed instantly by the second car ahead of ours. Never, I believe, did 3,500 miles in an airplane involve as much danger as this fast trip.

Each member of our party returned convinced that we would be making such journeys in privately-owned aircraft within ten years. The roads are becoming more and more crowded and dangerous—the airways less so. The human race soon will have to take to the air for safety's sake.

What will accelerate this desire for flight in the mass of humanity? What basic part of the present day aircraft needs improvement most? The answer is wings. The Wright brothers clearly saw that the problem of flight was mainly that of providing safe wings. Juan de la Cierva, inventor of the Autogiro, came to the same inevitable conclusion. The wing always has been and still is, the most fertile field for aeronautical inventors.

Every air-minded person is familiar with the faults of the present rigid airplane wing. Compare it with the bird's wing that may be varied in area and angle of incidence from minute to minute to meet changing conditions of air and speed. Imagine a bird trying to fly, and especially to take off and land, with two boards fixed rigidly to its body.

By this comparison I do not mean to imply that, in my opinion, the wing of the future necessarily will be like a bird's wing. When the wheel came, it was not similar to the levers of a kangaroo's legs. Just as man developed this wheel, superior to an animal's limbs, so he should develop a wing that is superior to that of a fowl. The inventor's problem is to conceive a wing which will be larger in area or otherwise have more lifting force when the plane takes off and lands than when it flies in the air. He must conceive a mechanical wing with a readily and safely variable lifting force.

Various means have been proposed for altering the present rigid type of wing to make its lifting force variable. There are hundreds of patents covering wings with slots which admit air from the lower to the upper surface; biplanes with foldable lower wings; hinged wing tips; telescoping wing tips and adjustable extensions.

Mr. Durmon, chief pilot of a large French airplane manufacturing company, flew a Makhonine airplane in 1932 that had telescoping wing ends. By mechanical means he stretched out the wing tips, thus increasing the area of the lifting surfaces until the plane had taken off. He retracted them and flew ahead with reduced wing surface.

Professor Werner Schmeidler also has experimented with such wing tips. They, no doubt, constitute an improvement in the present rigid type of wing. The main fault, however, with all the known means of making the wing surface variable, is that of the bracing, gears, shafts and other elements that have been designed to operate them under high air pressures. They have increased the weight of the craft too much for the degree of increased safety.

Some people, including the Junkers company and the Farman brothers, believe that the solution of the immediate wing problem is to build planes with an immense wing spread to enable them to take off and land with safety and to fly them at altitudes of 60,000 feet or more, where the large wings will not retard their speed because of the lower resistance of the upper air. The craft which these inventors are designing have airtight cockpits and double walls in which normal earth-surface air pressures and temperatures will be con-

The compactness of the "Vacuplane" (left) is very pronounced when compared to the Autogiro standing beside it. The lifting cell of the Vacuplane is directly above the body.

Where Is It Leading Us?

JUST what means of providing lift will be adopted in the future is a matter of doubt, but it is certain that the present airplane wing does not perfectly fulfill its purpose and that improvements are in order.

The author, a patent expert, reviews many of the proposed methods of improvement that have been advanced by the many inventors now working on the problem.

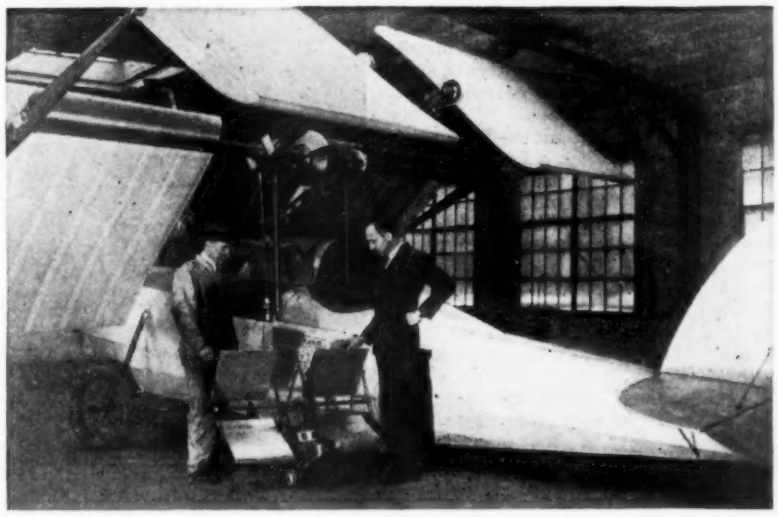
stantly maintained by devices that remind one of those controlling the air on a submarine.

Such a giant plane for the stratosphere was designed in the United States in 1927 and the huge Junkers G-38 is now flying between London and the European continent.

Juan de la Cierva, as almost everyone knows, created fairly safe wings in his well-known autogiro by hinging them and allowing the wind to rotate them. This type of wing, altered perhaps, probably will be adopted by the average citizen for ordinary individual aircraft travel in the immediate future.

The idea of an ornithopter, or aircraft with flapping wings, is as old as aviation. Since man first began to emulate the birds, a great deal of creative energy has been expended by inventors in the attempt to make one of these machines work. Gustave Lilienthal, brother of Otto Lilienthal and pioneer of aviation, has been working on the problem for many years without success.

Far be it from me to prophesy that no practical ornithopter ever will be built; my experience in research in the history of invention convinces me that when the human race attacks any problem — short of perpetual motion — it sooner or later finds a solution. But I believe that no practical machine will fly by flapping its wings up and down, like a bird, in the near future.



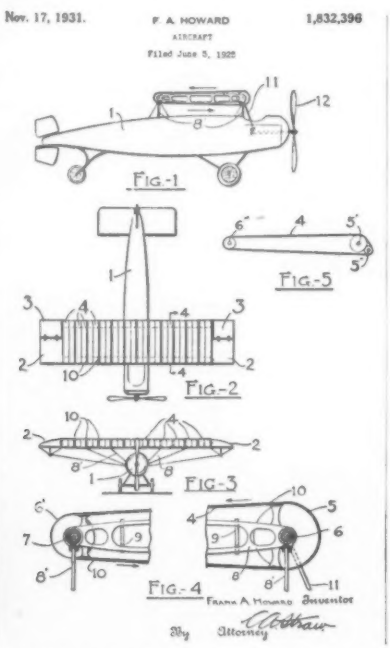
A full size American paddle ship is shown in the background while the working model of the ship is in the center foreground. The paddles drive down the air much like the old fashioned side-wheel steamers act on the water.

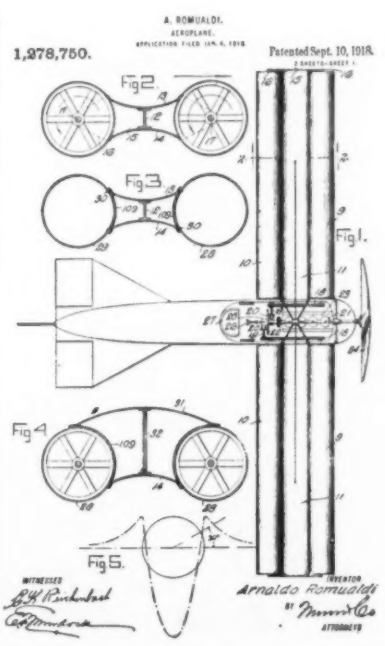
Proposed aircraft utilizing the Magnus effect or Flettner principle are interesting. Most people erroneously believe that Anton Flettner, the inventor and builder of the Flettner rotor ship, was first to conceive this principle. In reality, it was discovered in the Nineteenth Century by Professor Heinrich Gustav Magnus while investigating a problem for a Prussian artillery commission.

In 1910, some fourteen years before Flettner made his trip across the Atlantic in his odd ship powered only by a tall rotating cylinder, Representative Butler Ames tested the lifting force of two steel and canvas rotors on the torpedo boat Bagley at Annapolis. Representative Ames designed in 1908 and patented in 1910 an aircraft to utilize such rotating cylinders in the place of wings. He thus was the first inventor to conceive that an aircraft might be made to fly by the Magnus effect.

Most of my mechanically inclined readers probably understand how this Magnus effect or principle supplies moving force. The easiest way to explain it is to point out its operation in a curved baseball. A baseball pitcher throws an "out" curve or "in" curve by rotating or twisting the ball on a vertical axis as it leaves his hand.

If he wants the ball to curve upwardly, he twists or rotates it on a horizontal axis, thus causing the lower surface of the ball to rotate against the wind and the upper surface to rotate with the wind. This puts greater air pressure on the bottom than on the upper part of the ball and forces it to rise, in accordance with the Magnus principle.





Two important patents on rotor type lifting surfaces that clearly indicate the operation of the rotor planes.

Sundberg, in 1910, patented a plane to make use of rotating cylinders in lieu of wings. Arnaldo Romualdi, Jersey City, New Jersey, was the next inventor in this new industrial art. In 1915 he designed an airplane in which a rotating roller, utilizing the lifting force of the Magnus effect, was placed just in front of the leading edge of each wing. The rotors were geared to the ordinary aircraft engines.

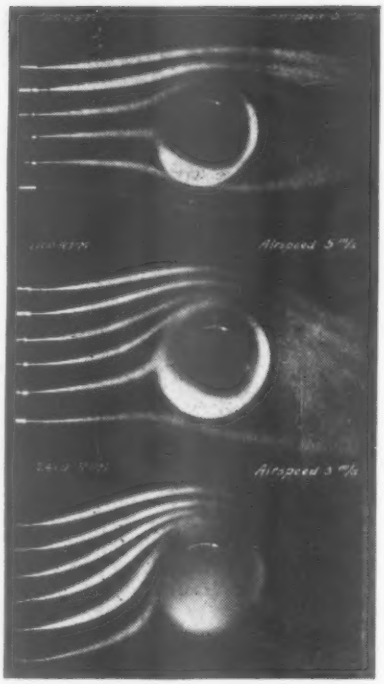
In 1915, two inventors—Philippart and Vuia—were given a French patent for the basic idea of making wings of moving endless bands of canvas, so that they would have the lifting effect of the ordinary wing plus that of the Magnus principle. In 1930, De la Tour Castelcicala patented an adaptation of this idea and in 1931 Howard patented a further adaptation and assigned it to the Standard Oil Development Company of New Jersey.

Then came Flettner, who patented his rotor-driven ship and aircraft in 1924. Since then, a great many inventors have worked in this art. Jordanoff of Ohio utilized rotating cylinders—like Romualdi's, in front of the leading edges of the wings—but driven by an extension of the crankshaft to the rear of the engine. Dally proposed to rotate the rotors by a turbine actuated by air from a funnel near the fuselage. Noeggerath and Short invented corrugated rotor-wings. Ripoche, France, proposed to house rotors in the middle portions of ordinary airplane wings while Picoli, Italy, suggested the filling of rotors with lighter-than-air-gas.

Frederick Wander of New York has received several patents on the adaptation of the Magnus principle to the helicopter and the Autogiro. Instead of the hinged rotating vanes of the de la Cierva windmill aircraft, he proposes to use hinged Flettner rotors.

Thus, we see that there is intense activity on this problem of flight by the Magnus principle all over the Western World. If I were a gambling man, I'd lay a dollar to a dime that some craft will fly by this principle in the next decade. I believe that an aircraft with short rotating cylinders of large diameter that are filled with buoyant gas is feasible. In taking off the cylinders could be rotated at high speed, to lift the machine, and once in the air they could be rotated slowly or not at all to decrease resistance to flight.

Another very interesting line of wing development, in which the general public no doubt will be increasingly interested in the next few months, is the paddle-wing plane. Paddle wheels as propellers for aircraft have been dreamed of since the days of their extensive use in steamboats. Several extremely old British patents and American patents as early as patent No. 397647 of 1889 were drawn to paddle-wheel planes. Since 1889, hundreds of others have been issued.



Smoke photograph of a revolving rotor in a wind-tunnel, showing the twisting effect of the rotor on the air stream.

Now comes Dr. Adolf K. Rohrback, President of the Rohrback Metal Airplane Construction Company, well-known designer and constructor of airplanes of high quality, who claims to have invented and to be now building a paddle-wing plane that not only will fly but will descend almost vertically, as lightly as a feather!

The craft has no screw propeller but is operated by a paddle-wheel composed of three revolving wings or vanes on each side of the fuselage. Each wing or vane is connected to a horizontal rotating shaft which extends into the fuselage where it is actuated by an engine. The pilot can alter the pitch of these vanes to change the speed and direction of flight. "As the wings revolve," states Dr. Rohrback, "the airfoils are automatically adjusted in pitch so that the foil momentarily at the top exerts a strong pull forward, the foil at the bottom pulls weakly upward, and the foil at the back is virtually neutral."

If this machine works as the inventor believes it will, it will without doubt revolutionize the aeronautical world. It should make flying as cheap and much more safe than traveling in a motor car.

A paddle-wheel flyer of the same general type is now being developed in the United States and a full size ship is now under construction. We will wait with great interest to see just what results are obtained with this radically new departure in flying machines. The American inventor claims several years priority over the invention of Dr. Rohrback.

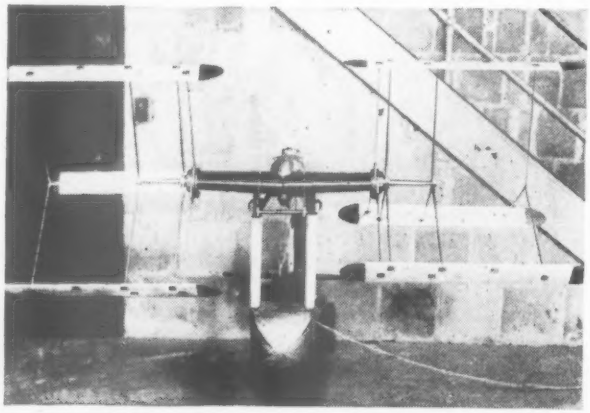
One of the most interesting departures from the standard bird-wing type of plane is the Lanier "Vacuplane" which is far more compact than any lifting surface yet devised and this has proved practicable by many flying tests with a full size machine.

The Lanier Vacuplane, an American invention, has a peculiar lifting cell placed just over the body. The cell is designed in such a way that a great reduction in pressure is obtained near the center of the device, a vacuum that is many times greater than that obtained over the upper surface of the standard wing. This produces a lift that is from four to five times greater per square foot of area than the ordinary wing.

Projecting on either side of this center cell are two deep thick wings that are given a sharp dihedral angle near the center section. The wings add to the lift, but their principle function is to maintain stability and maneuverability in flight. By concentrating the lift directly over the body, the machine is made much more compact and the stresses are also greatly reduced. It is said that it is impossible to stall this machine or to cause spinning.

A stationary cell or lifting surface has the advantage.

We are living in an age that in every sense is changing so fast that it often makes our heads swim. Thus it may be said without fear of contradiction that before we know it even, we may be flying from country homes, equipped with television and automatic heating and humidifying heating and humidifying means, to the day's work in the city in a standardized autogiro, helicopter or paddle-wing plane.



A model of a Rohrback paddle ship which greatly resembles the "side-wheel" steamers on the Mississippi River.

Some Inspectors I Have Met

by WILLIAM L. HOPSON

Here, the author declares, there are all sorts of Dep-Com inspectors, good, tolerant, intolerant and just plain ——. Mostly, however, they're inclined to give the pilot a break if he isn't just too bad.

CORRECT me if I'm wrong, Gentle Reader, but if all pilots are like the ones that I know—and I've run across a lot of them while knocking about the country—they all get a feeling of uncomfortableness somewhere in the immediate vicinity of their middle regions when they look up from whatever they're doing to see one of Uncle Sam's fish-eyed representatives come stalking onto the field.

The feeling usually changes to an acute something-or-other when the said representative suddenly changes his course and sets sail in the direction of your own particular sky-buggy and begins to expertly thump a rib here, cut a hole in the fabric there or pokes his smeller into the innards behind the motor and begins to look around like pussy searching the attic for a stray mouse. Some of these western writers who babble about the "steel of the eye is better than the steel of the gun," should buy a second-hand crate that needs inspecting and get a few pointers. Take it from a man who knows!

I've met quite a number of Uncle Sam's Gifts to Aviation, whose business is partly to make bad boy aviators hunt a hole, crawl into it and then pull it in on top of them. Some of the gentlemen were very very good; some of the gentlemen were not so good; while one of the gentlemen was just plain h--l.

F'r instance:

One summer, not too many years ago, I was jumping chutes for an outfit up north. The outfit consisted of Charlie, a dizzy Swede pilot; Cliff, the owner of the Whirlwind cabin job we were using, and then there was Mrs. Hopson's pride but not joy. We would usually barnstorm most of the week and then come home for the week-end to the little town where we would hop passengers during Sunday. We had a small two room shack rented on the airport where the three of us ate, slept and made beer.

On the day that we made the acquaintance of this Inspector (I'll call him Smith), who was so very, very good, the three of us were taking it easy in our shack. As a matter of fact, we had been taking it easy for several days.

It seems that a few days before Smith's visit, a farmer had come roaring into the office of the town clown (I mean town marshal), with the news that while harrowing his field the day before he had gone to the house for a drink of water and had come back just in time to see the harrow and team disappear in a cloud of dust across a newly planted field. Then a low flying airplane disappeared on the horizon (Charley always did like to hedge-hop).

Smile sweetly, young lady, but I'll bet you get the Big Ticket just the same from the handsome inspector.

"—And you've got to do something about it Marshal!" bawled the indignant tax-payer.

And Mr. Town Clown had done plenty!

The three of us were in the middle of a heated argument as to whose turn it was to wash the three day's accumulation of dirty dishes when we were interrupted by a knock on the door.

"Well, open it an' come on in, you —— polecat!" yelled Charley. Charley always prided himself on his hospitality.

The door opened and in came a small, wiry built fellow with a close clipped black mustachio. "Thanks," he grins, "My name is Smith and I'm replacing Mr. —— as aircraft inspector for this district—."

BAM!

Right then and there we knew that somebody was going to get it in the neck. The big question was who and how many. First of all, there was Charley. He hadn't done so *very* much. Outside of flying a ship on which he held no rating, stunting with passengers and diving at a few bossies in a nearby pasture—most of which grazed with a weather eye cocked sky-ward—he had a pretty good record.

Cliff didn't have so much to worry about. All he'd done was to fly his ship without a student's permit, carry me up for ballast when he soloed and later while he practiced shooting landings. As for me I was sitting pretty good. All I had been doing was to jump with an old style exhibition type chute when the regulations called for two approved type pack chutes. So I knew—oh, yes—I didn't have a parachute rigger's license either.

Well, we gulped a greeting to Inspector Smith, invited him to pull up a chair and sat down to wait for the fireworks to begin. Mr. Smith laid his brief-case on a chair, pulled up another for himself, sat down and lighted a cigarette.

"Nice little place you have here," he remarks, waving his hand around, "Handy and all that sort of thing. Well, how's the flying game?"

He didn't seem in too big a hurry to get down to business so we started ground flying. He sure was a pleasant cuss. For the next hour he regaled us with yarns of his army flying days and he could tell more funny stories than any man I ever heard.

But it couldn't last always. Inspector Smith finally finished his last yarn and cigarette and rose to his feet. He collected Charley's license and plastered a heavy fine on him for stunting with passengers, gave Cliff another fine for flying his ship without a student's permit and advised me to quit jumping chutes until I got some better equipment and a parachute rigger's license. Then he went over to the piano in the corner, played a couple of tunes and blithely took his departure. Sugar with the castor oil, what!

But he sure was a square shooter. Less than two weeks later he almost lost his job because he tried to give a pilot a break. He was to give the pilot a test on the cabin job he was flying for another fellow—and an hour before time for the test, a passenger came out to the field to charter the ship for a flight of several hundred miles that he wanted to make in a hurry. With times as tough as they were, Inspector Smith let him go, "But for heaven's sake don't crack up," he warned, "or I'll catch hell from higher up."

And of course they cracked up on the way. A conked motor on the take-off. I happen to know that on the day following, Inspector Smith, in answer to a telegram from headquarters, flew several hundred miles to go on the carpet for one of the worst bawling outs that a man ever got. All because he tried to give a pilot a little the best of it.

I once read an article in POPULAR AVIATION dealing with some of the wild goose chases that some of the inspec-

tors often have to go on. It cited one particular incident of Bill Moore, assistant supervisor at Oakland to "Papa" Mouton, and I little realized at the time that I would also be the cause of Moore making a futile trip.

I wrote in from a town up north, applying for a parachute rigger's license; In due time came the usual blanks to fill out, etc., and finally a notice from Moore that he would arrive on a certain day to give me my examination.

The day before he was to arrive, however, I had to make a sudden trip to Astoria, Oregon; so we crawled in a car and drove through that night. Fool like, I didn't wire Moore until after I had arrived in Astoria. And imagine my embarrassment when Mouton wired me that Moore was already on his way to where I was supposed to be. Boy, oh boy, was my face red!

I wired him that I would come to Oakland for my exam if he would call it square. Then, next day, a friend of mine who owned an OX5 Waco and I crawled in his ship and flew over to Seaside, Oregon, and began to hop passengers on the beach.

During a lull in business that afternoon, we suddenly heard the motor of another ship and looked up to see a Whirlwind Stearman, with the Department of Commerce insignia on the wings, circle for a landing. Right then, Mrs. Hopson's son began to wish that he had never seen an airplane.

Moore cut the gun, sat her down on the hard sand of the beach and taxied up to where we were. He cut the switches, crawled out and asked for me. He had landed at Astoria and had found out from someone at the field where we had gone. Half scared to death, I went over and shook hands with him and explained my side of things—expecting him to cut loose and give me hell any second.

But to my pleasant surprise and relief, he didn't. To my profuse apologies he only grinned and said, "Oh, that's all right; I kinda wanted to see the rodeo at Pendleton anyway. Mouton cut me off there with a telegram when I landed for fuel."

You don't find many like that.

About the meanest representative of the Department of Commerce that I ever met was a fellow who gave a chute jumping friend of mine a pretty dirty deal. This friend had been billed at a celebration for a jump from a six-place cabin job, and was to use a regular exhibition type chute with a 28 foot Irving back-pack for an emergency chute. This particular inspector had arrived in town a few days before and after having things explained to him, had consented to let him go ahead and jump. The chutes had been packed by a licensed rigger.

Came the time for the jump and the jumper went up and bailed out. He

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The Aero-Sportswomen

by JOAN THOMAS

FRANCES PARKINSON KEYES, well known author and traveler, would like to know why air-transportation companies apparently are so indifferent to business!

"I cannot understand," she said, speaking before the aviation round-table at the annual convention of the Business and Professional Women's Clubs, "why the air lines do not feel that it is necessary to advertise as the steamship companies and railroads do.

"I travel a great deal," she continued, "and I receive quantities of the most interesting circulars about places and how to get there—and when I begin to plan a voyage the different steamship companies send their representatives to see me and make most attractive offers to induce me to use their lines. But if I decide to go by air, I must go to the company myself for the information, and instead of trying to impress me on the beauties and comfort of travel by air, they actually seem indifferent whether I use their lines or not."

Mrs. Keyes was speaking from the viewpoint of the average person, for she is an enthusiastic air-traveler and believes that it is only a matter of time until it will become as commonplace as any other form of transportation. She feels that the air lines are losing valuable time by ineffective and utterly impersonal methods.

"I should have been asked to speak on flying instead of writing," Mrs. Keyes laughingly remarked to the editor of this column, "I am sure some of my experiences flying over the Andes or through the sand-storms of a Persian desert would have been more interesting than anything I could have said about journalism."

From left to right: Alice Herschman, Gusse Paint, Joyce Hartung, Mrs. Gladys Hartung, Ruth Kitchel Hakeman, Margaret J. Horton.

There are few women who have had more opportunities to travel than Mrs. Keyes. She first became well-known through a series of articles called "Letters from a Senator's wife" which were published in a national magazine. Later she went to Europe to write a series of travel articles.

It was on a similar trip to South America in 1929, that she took her first airplane ride, a sight-seeing trip over

(*Concluded on page* 336)

Frances Parkinson Keyes, well known author and traveler, who travels via the air lines whenever possible.

The Army Non-Rigid TC-13

by WALTER E. BURTON

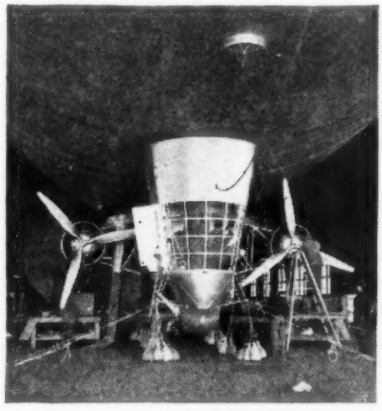
There are many novel constructional and operative details incorporated in the design of the U. S. latest non-rigid airship. The TC-13 is the largest non-rigid ever built in America.

THE largest non-rigid airship ever built in America, the TC-13 completed by the Goodyear-Zeppelin Corporation for the U. S. Army Air Corps, has numerous features found in the past only in large, Zeppelin-type ships.

The TC-13 is more than 200 feet long and displaces 11 tons of air. Of this, 4½ tons is available for useful load including fuel, armament, equipment and the crew of six men. The ship can make extended flights of four or five days, sleeping quarters, facilities for preparing meals, and other accommodations being provided.

The new airship is of the non-rigid type, having no framework inside the gas envelope, but depending entirely on helium pressure created through the inflation of balloonets, to keep the bag in shape.

The 40-foot car is attached directly below the envelope by concealed wires and its bottom is shaped like a boat so that the airship can land on water. A canvas sea anchor, resembling an umbrella, will be used to prevent drifting.



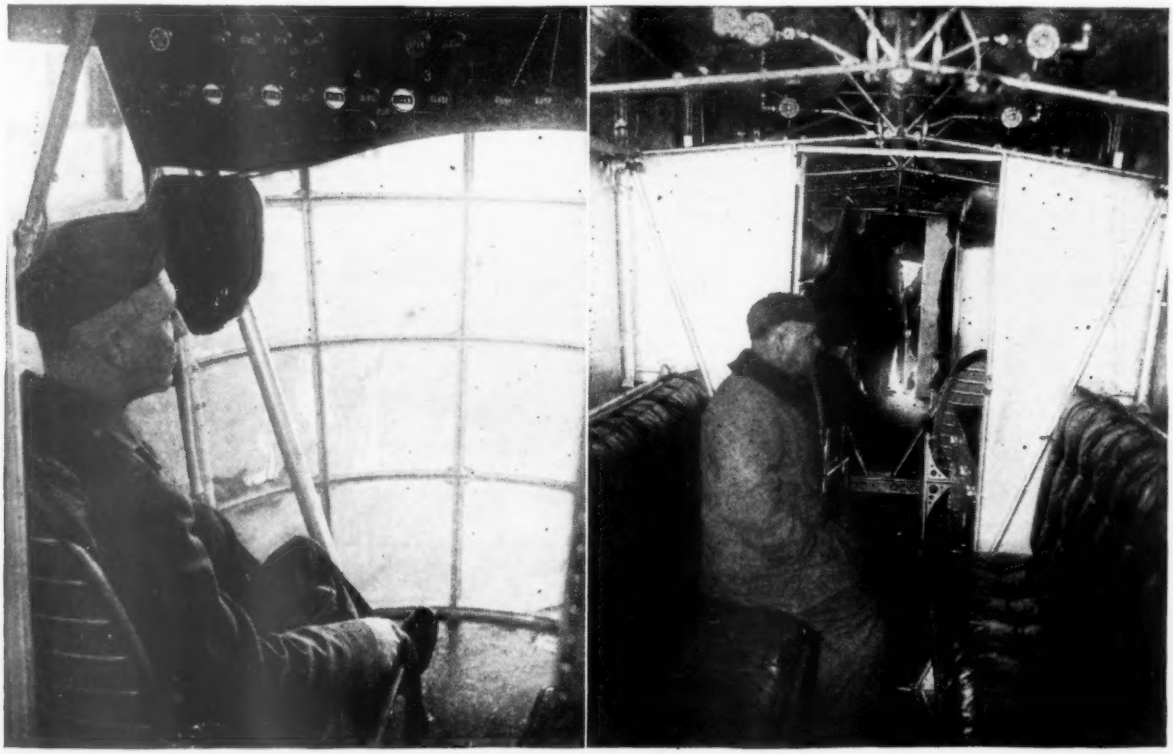
Control car and the two 375 h.p. engines as seen from a position forward. An inflated bumper absorbs shocks when car strikes ground.

Something new in military blimp equipment is the spy basket or observation car that can be dropped down by means of a cable while the ship remains above clouds. An observer in the car is connected by telephone with the airship, and can direct its flight. Experiments with various kinds of observation and photographic activities are planned.

The car itself is made of wood, streamlined; and is painted a color that will render it practically invisible against a cloud layer. A windlass operated by a small gasoline motor can raise the car at the rate of 200 feet per minute. Automatic brakes prevent the car from dropping too rapidly when it is being lowered.

By means of walkways, crew members can reach the two 375-horsepower engines, mounted on outriggers, at any time during flight, for adjustment or repairs. The 12-ft. propellers are driven at comparatively slow speeds through gears. Special efforts have been made to muffle the engines and reduce propeller noise by use of gears, so that the TC-13 will be one of the most silent airships ever built.

In addition to the two main engines and the one driving the spy-basket windlass, there is a small marine type engine for driving an air blower used



Interior views taken in the TC-13. At the left, the pilot is sitting at the controls of the airship. The buttons above him control the helium valves, air pressure, etc. At the right is a view of the sleeping quarters. The seat backs can be raised at night to provide an upper bunk.

to inflate the balloonets when the ship is not moving fast enough through the air; and another marine engine for driving an auxiliary radio generator.

The latest type two-way, long-range radio equipment is installed on the TC-13. There is a special direction finder in addition to regular navigation instruments required for operation over water. Bomb racks and machine gun mounts have been built into the car.

Fuel tanks of the airship are used for holding water ballast when they are empty, so that the loss of weight caused by use of fuel is overcome. Instead of using exhaust-vapor condensers as in larger airships, the new blimp will employ an apparatus that is dropped into the ocean or other body of water while the ship flies at slow speed, and is then raised into the control car and pumped into the empty fuel tanks. The windlass used for operating the spy basket is used also for bringing water aboard. Mixture of water and fuel is prevented by use of special segregators.

The TC-13 was designed by the Air Corps Materiel Division at Dayton, Ohio, and represents the last word in non-rigid construction. By using improved materials, methods and design, it has been found possible to include much equipment formerly considered impossible on a ship of its size.

The new blimp will be attached to a mooring mast by a fixture located half way between the nose of the envelope and the car. A portable mooring mast, similar to those used for handling Zeppelin type airships, is being developed for use in ground handling of the TC-13. The mast will be moved about by a tractor, drawing the ship into or out of the hangar.

The new ship will be stationed at Langley Field, Virginia, while it is used for studies to determine the value of such craft for coast patrol work.

During the World War, airships of this type called "Coastal Types," or "Blimps," were of great service in locating submarines, sunken wrecks and similar under-water observations. More than once, along the English coast, bombs dropped from the blimps sank submarines or else warned shipping of the presence of the undersea-craft. The airship has a steady platform, and when at a fair height, can detect objects far below the surface.

Being of comparatively small dimensions, they are much more maneuverable than the large rigid types; they are much less expensive, both in regard to first cost and cost of operation, and are more practical in military operations than the rigid dirigible. For a better understanding of the dirigible principle, the reader is referred to "Practical Lesson in Aviation" in this issue.

Many of the early difficulties have been solved in the TC-13 which gave rise to a considerable amount of trouble with the old blimps.

Elementary Stress Analysis

by LES LONG

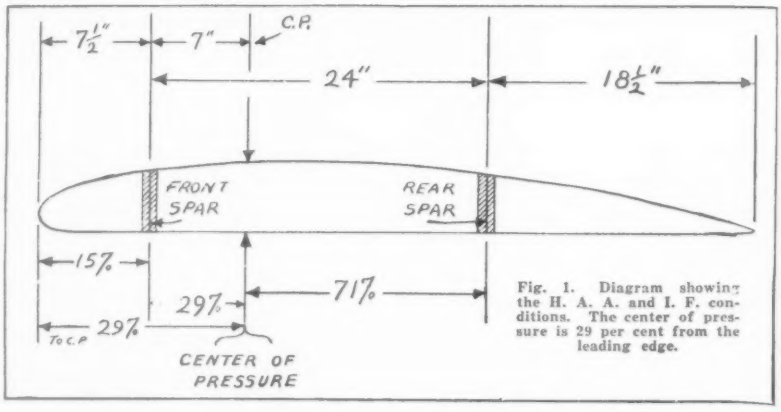


Fig. 1. Diagram showing the H. A. A. and I. F. conditions. The center of pressure is 29 per cent from the leading edge.

IN THE August issue we explained how to calculate some of the primary loads that are imposed on a wing truss. The wing was treated as though it had but a single beam (spar) and a single lift strut. We shall now show how the loads are distributed when the wing has the customary two beams and corresponding lift struts.

It is unfortunate, but true, that all wing sections have a shifting center of pressure. Some are much worse than others in this respect, but with any standard wing we must always contend with the fact that the distribution of loads on the two beams varies with the angle of attack. When calculating such loads, it is standard practice to consider three different attitudes of the wing in respect to its relative wind. These are High Angle of Attack, (H. A. A.) Low Angle of Attack, (L. A. A.) and Inverted Flight (I. F.) The position for the center of pressure in inverted flight is considered the same as in H. A. A.

For most standard wing sections, the positions of the center of pressure in the three attitudes have been determined. On the average they lie between 30 per cent of the chord for a H. A. A. and I. F., and 50 per cent of chord for the L. A. A. Taking the Clark Y, which is the only one we shall consider here, the H. A. A. and I. F. are given as 29 per cent and the L. A. A. as 47 per cent.

Now, it is plain to be seen that when the wing is at a high angle of attack, as when the ship is climbing rapidly, the center of pressure is far forward and consequently the front beam takes practically all of the load. When diving or levelling out at the top of a climb, the angle of attack is low and the center of pressure moves back so that the rear beam takes most of the load—in some cases, all of it.

In order to determine the loads under these varying conditions, we must find out just where the center of pressure comes in relation to the beams. First, we make a drawing of the section to scale. We will assume that the wing under consideration has a 50-inch chord. This means that every half inch of the chord represents 1 per cent of the chord.

As our drawing is full size, we will locate our front beam at 7½ inches from the leading edge, which is 15 per cent of the chord. We will locate the rear beam at 63 per cent of the chord, which is 31½ inches from the leading edge. This spaces the beams just 2 feet apart.

Looking at drawing No. 1, which shows the H. A. A. and I. F. condition, we see that the center of pressure (C.

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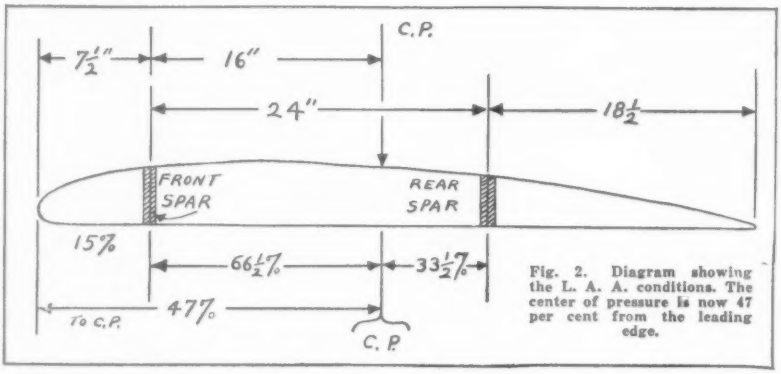

Fig. 2. Diagram showing the L. A. A. conditions. The center of pressure is now 47 per cent from the leading edge.

They All Read 'Ole P. A.

by CARL B. OGILVIE

Our author, whom you all remember by reason of his excellent war stories, was amazed at the popularity of POPULAR AVIATION at the airports — and with air men. Read what he says about it.

In the first picture, left to right, we see Ken Unger, owner and operator of the Unger Flying Service, devouring his copy of P. A. Then, in the second frame, Johnny Perri (right) is gabfesting with Byron Hardy. Third, we see that Johnny Perri has his copy. Last, but not least, is Dick Bircher, stunt flyer and ardent reader of POPULAR AVIATION.

VERY frequently, I visit the airports within shooting distance of my New Jersey home and I make it a point to take in the air-meets, dedicational or otherwise. And when I go, I take in the main show, side shows, personnel, personalities and all the rest of it.

But, in all my travels about the cow-pastures, I made note of one remarkable fact, and later determined to make a record of this observation so that I could prove it to the readers of POPULAR AVIATION. And the fact was this, that at every airport that I visited, 'ole P. A. was a prominent part of the landscape. Yessir, at New Brunswick, Brielle, Camden, Somerset Hills and Forked River—all N. J.—they read P. A., liked it and said so. Just listen to a few examples.

Kenneth B. Dates (left) and George A. Viehmann use a copy of P. A. between them. Mr. Viehman is manager of the Standard Flying Service.

1 "KEN" Unger, world war pilot, one of the only two surviving pilots of the Royal Air Force, 210 th. Squadron, a member of the Caterpillar Club, and owner and operator of four Unger Service flying fields in New Jersey, is evidently a staunch advocate of the important factor of "dependability." He is shown with his parachute and POPULAR AVIATION Magazine, both rating high ratios of dependability.

* * *

2 WHAT do parachute men talk about when they get together? Johnnie Perri, Eastern champion parachute jumper, with a delayed drop record of 11,000 feet, is saying things to Byron Hardy, a "slip 'chuter" of Manasquan, N. J. Will bet it's something about that copy of POPULAR AVIATION tucked in Hardy's hip pocket.

* * *

3 LOOKS like Perri won the argument with Hardy. The eastern champ is rounding a wing to take off for his 229th. free drop, with a copy of POPULAR AVIATION Magazine in his hand.

* * *

4 THE Pylon Club of Philadelphia, Pa. has some mighty fine pilots. Here's introducing Dick Bircher, club member, who knocks judges and spectators at air meets for a row of silver loving cups when he puts on his spectacular series of aerobatics. Dick's specialty is the thrilling inverted flying. He gets a thrill out of reading POPULAR AVIATION.

5 HENRY Apgar, manager of Forked River flying field, Forked River, N. J., and his two helpers, Edward Emmons of Manasquan (left) and Gene Thompson of West Long Branch, take time off servicing a 2 cylinder 36 H. P. Aeronca to settle an aerodynamic question, using POPULAR AVIATION as authority and mediator.

* * *

6 JUDGING by the smiles of Pilot Kenneth B. Dates (left) and

Henry Apgar (center) does a threesome with Edward Emmons (left) and Gene Thompson, his helpers.

George A. Viehmann, POPULAR AVIATION makes a perfect three pointer at Somerset Hills Airport. Viehmann is manager of the Standard Flying Service of Basking Ridge, N. J. Dates hops cross-country to keep dates and win first money in bomb dropping contests.

Priority in Army Air Schools

WE HAVE had so many inquiries from our readers regarding appointments to the U. S. Army Air Corps schools, we feel that many will be interested in the recent announcement concerning priorities issued by the War Department.

It is to be understood that beginners are first taken into the primary training school at Randolph Field, Texas, and upon graduation are then sent to the advanced school at Kelly Field. As will be seen from the following tabulated sequence, which gives the preferences of the War Department in numerical order, that West-Point graduates are the most desirable and are given first chance. Then follow other men from the service and finally civilians.

We understand that it is the policy of the U. S. Army Air Corps to give army officers auxiliary training in aviation rather than to simply develop pilots. Proper military training is as essential as flight training, hence military men have precedence over civilians.

1. Graduates of West-Point Military Academy, the U. S. Army school for officers.
2. Graduates of Annapolis, the U. S. Navy school for naval officers.
3. Graduates of U. S. Coast Guard Academy, New London, Conn.
4. Enlisted men from the U. S. Army Air Corps and from other branches of the regular U. S. Army with at least 11 months service.
5. Officers and enlisted men of the National Guard with at least 11 months service with Air Corps Units.
6. College graduates who are also graduates of Air Corps R. O. T. C. units and similar units of other arms or service.
7. Graduates of recognized universities and colleges.
8. Officers and enlisted men of the National Guard with at least 11 months service.
9. College students who are members of Air Corps R. O. T. C. units and who have completed their junior year.
10. Reserve officers and enlisted men with at least 11 months' service.
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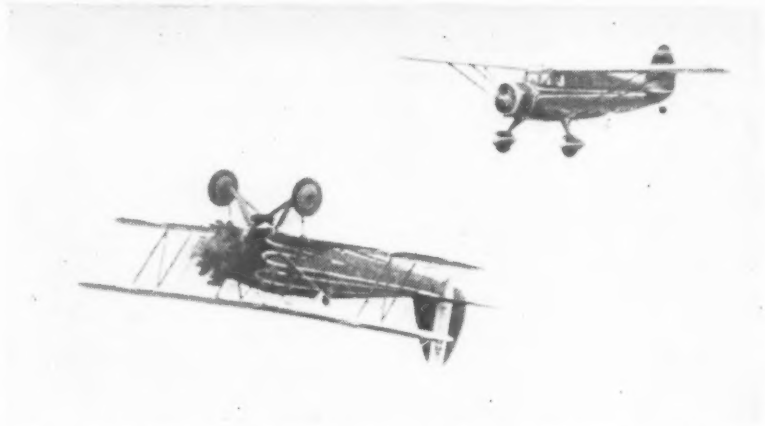

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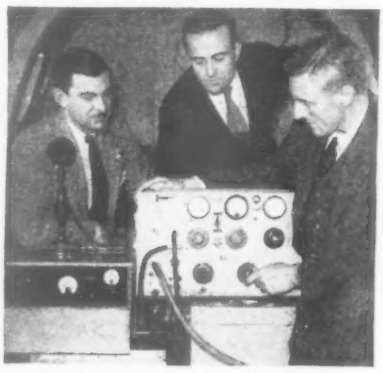

The sound-engineers making noise tests in the cabin.

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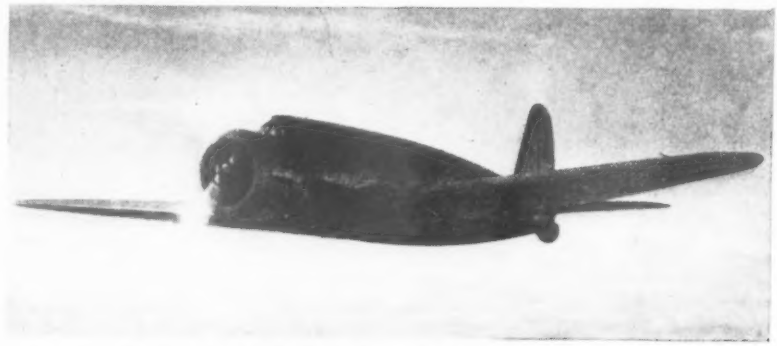

The sound-proofed plane in flight. More silent then a street-car.

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It's easy enough for anyone, even little five-year-old Reginald, to visualize forward speed or horizontal speed. This is the motion that is comparable with that of automobiles, horses and buggies and all the rest of the old time vehicles, wheelbarrows included. We usually quote the forward speed in terms of miles-per-hour when talking with John Public, but in the quiet of the drafting room or laboratory, it is more often given in terms of feet-per-minute or feet-per-second because these units more easily enter in calculations.

The steepness of the climbing path, in the case of this plane, is nearly 45 degrees. In a large measure, it is attained by the use of wing slots and flaps which control the air-flow over the wing at high angles of wing attack. The rate of climb is not so greatly affected as the steepness of the ascent with the wing slots and flaps. The wing slots are the two hinged "dampers" shown on the entering edge of the wing.

Now, from our experience with automobiles, airplanes and wheel-barrows, we know that they don't go forward all by themselves. They have to be pushed or pulled or something—usually with a whole lot of effort on the part of the pusher. And the faster we push them, the more exertion or power we must expend. In fact, the effort or power required increases more rapidly than the increase in speed. We can usually push a small car by hand up to five miles per hour, but to propel it at 60 m.p.h. requires quite a large engine and that engine will be working hard.

In the case of the automobile, part of the power is used in over-coming the friction of the bearings and the wheels on the road, but at high speed, by far the greater part of the power is expended in producing air eddies and currents, or as it is called, overcoming the "air resistance." In horizontal flight, we have no wheels nor bearings to cause friction on the plane itself, but we also expend power in other ways, even though the plane is apparently floating in the air.

In the first place, we must expend power for suspending the plane in the air. This is not necessary with the automobile because it is supported directly by the ground on which it stands. Neither is it necessary to expend power to any great extent to support a dirigible or balloon, for these bodies are suspended largely by the buoyancy of the hydrogen or helium gas contained in their envelopes. However, because of the nature of the airplane, which is supported by the reaction of downwardly deflected air, we must keep the engine going at all times in order to deflect this air downwards just so long as the plane is in flight.

In addition to the power required for sustention in the air, comes the power required for overcoming the resistance offered to the air by the body of the ship and the other parts hanging in the wind-stream, so that the total amount of resistance or drag to be overcome by the power plant amounts to a considerable figure. Still more power is required for climbing or for increasing the altitude of the plane as will be explained later on. It takes a whole lot of power to drive a plane along the level and a whole lot more to jump it up to 20,000 feet in a few minutes.

In Fig. 1 (next page) we have the free floating spherical balloon that is entirely suspended by the buoyancy of the gas. It will float indefinitely without power, just so long as a sufficiency of gas is left in the envelope. The dirigible in Fig. 2 is mostly suspended by gas although some lift is also obtained under certain conditions by the air impact on the lower part of the ship.

However, to move the dirigible forward requires propeller thrust (T) which, of course, is supplied by the engine. When fully gas floated, the thrust (T) represents only the frictional drag of the air or air resistance of the hull which is equal to and opposite to the prop thrust.

Then, we have the airplane represented by Fig. 3 in which lift is entirely produced by the reaction of the downwardly dedeflected air, the air being swept down by the wings. In order to produce lift by this means, the plane must be kept moving forward continuously by the propeller thrust (T), hence the total thrust (T) produced by the power plant to maintain horizontal flight must be the sum of the resistance of the plane plus the drag resulting from the lift or supporting force.

Without going into all of the quite complicated technical details, it will be sufficient to state that the drag of the wings and the resistance of the body do not follow the same laws when the speed of the airplane is varied. For example, the resistance of the body, landing gear, etc., increases as the "square of the speed," while the power required for support by the wings varies at a much lower rate. At top speed, the wing angle is small so that

Priority in Army Air Schools

WE HAVE had so many inquiries from our readers regarding appointments to the U. S. Army Air Corps schools, we feel that many will be interested in the recent announcement concerning priorities issued by the War Department.

It is to be understood that beginners are first taken into the primary training school at Randolph Field, Texas, and upon graduation are then sent to the advanced school at Kelly Field. As will be seen from the following tabulated sequence, which gives the preferences of the War Department in numerical order, that West-Point graduates are the most desirable and are given first chance. Then follow other men from the service and finally civilians.

We understand that it is the policy of the U. S. Army Air Corps to give army officers auxiliary training in aviation rather than to simply develop pilots. Proper military training is as essential as flight training, hence military men have precedence over civilians.

1. Graduates of West-Point Military Academy, the U. S. Army school for officers.
2. Graduates of Annapolis, the U. S. Navy school for naval officers.
3. Graduates of U. S. Coast Guard Academy, New London, Conn.
4. Enlisted men from the U. S. Army Air Corps and from other branches of the regular U. S. Army with at least 11 months service.
5. Officers and enlisted men of the National Guard with at least 11 months service with Air Corps Units.
6. College graduates who are also graduates of Air Corps R. O. T. C. units and similar units of other arms or service.
7. Graduates of recognized universities and colleges.
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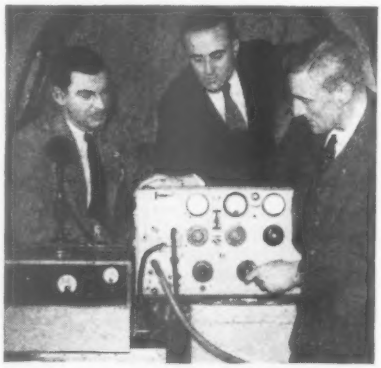

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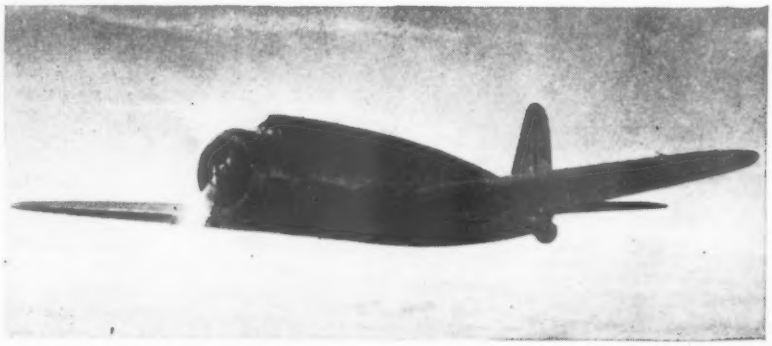

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the relative drag may decrease within certain limits.

The total result of this variation is the fact that there is one speed at which the least power is demanded of the engine. If the speed is reduced below this "optimum speed," the wing drag increases and the power demand increases. If the speed is greater than the optimum, then the body resistance or parasitic resistance increases and there is again a demand for more power.

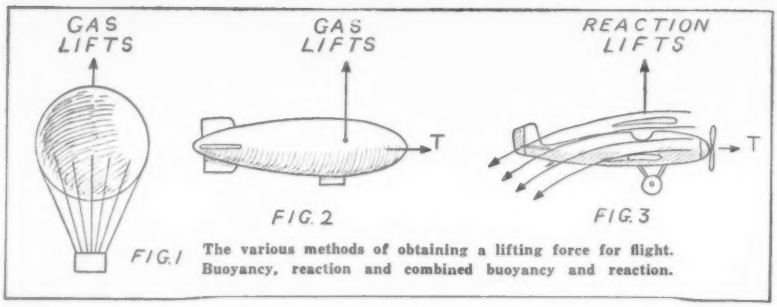
Usually, the least power is required near or at that speed where the wing drag is equal to the body resistance. And what I particularly wish you to observe is the fact that the engine consequently has a greater surplus of power at the optimum speed. At top speed there is no surplus of power for the reason that every ounce of effort is being consumed in driving the ship forward against parasite resistance while at very low speeds, the great angle of the wing is consuming a great percentage of the engine output.

Perhaps, if you are not afraid of graphs, this is best indicated by the diagram of Fig. 4 which gives an idea of how the power demand varies at different speeds in horizontal flight. Thus, at the lowest possible speed (L) of 40 M.P.H. it will require 30 horsepower. However at 60 M.P.H. the ship will draw only 20 horsepower, while at 120 M.P.H., the engine must deliver 70 horsepower as at (M).

Since this is a 70 horsepower engine (dotted line a-a), all of the power will be consumed at the high speed (M). Actually, the engine power varies somewhat at different speeds but for the sake of simplicity we have assumed a constant output as indicated by the straight line (a-a).

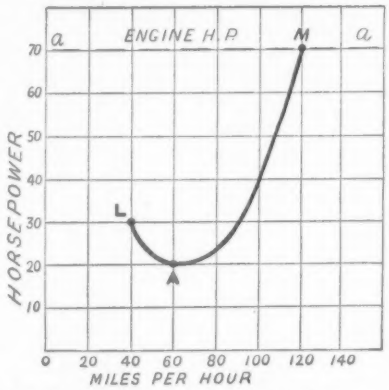
And now we get to the subject of climbing because an airplane climbs with the surplus of power left in the engine after the power for horizontal flight is deducted. We must first have sufficient power to propel the ship forward and to provide lift, and if the engine still has power left over, we can climb. The greater the amount of excess power over that required for horizontal flight, the faster we can climb. It is simply a matter of mechanics.

After we think the matter over, we will rapidly see that the rate of climb



The various methods of obtaining a lifting force for flight. Buoyancy, reaction and combined buoyancy and reaction.

is different at different forward speeds. Thus, at the point (A) on the graph, where the least power is required for flight, it is obvious that we will have the greatest reserve power for climbing, hence the best climb for this ship will be near 60 m.p.h. At the top speed (M) of 120 m.p.h. there is no reserve and therefore we cannot climb. At a speed of 60 m.p.h., the reserve for climbing will be: 70 h.p.—20 h.p.=50 h.p. Similarly at 100 m.p.h. the reserve power will be reduced to: 70—40 =30 h.p.



Fog. 4. Typical power-speed graph of an airplane in flight.

Climbing, or lifting an airplane through a certain number of feet per minute is just the same thing as lifting any other weight at the same speed.

Say that we have a hoist lifting a weight from the position (A) to a position (B) or through a height (H). In lifting the weight or the plane, work must be supplied by an engine or otherwise, the work being in terms of "foot-pounds." The work in foot-pounds is equal to the weight in pounds multiplied by the distance (H) in feet.

However, when the work is to be performed in a given length of time, as in one minute, one second or one hour, then the term "power" enters the problem. "Power," let it be known, is the rate of doing work, and the horsepower is the rate of doing 33,000 foot-pounds of work in one minute, or 550 foot-pounds in one second. One horsepower will be required if 33,000 pounds are raised one foot in one minute, or if one pound is raised 33,000 feet in one minute, or any other product of pounds and feet amounting to 33,000 per minute

For example. It an airplane weighing 3,300 pounds is climbing at the rate of 100 feet per minute, then the power taken for raising the plane is equal to: 3,300 x 100=330,000=10 horsepower. This, you understand, is aside from and in addition to the power required for horizontal flight.

Now, you can see just how the surplus engine power is employed for climbing an airplane. If there is a surlus of 50 h.p. at 60 m.p.h., as indicated by the graph, then it is easy to find out what the best climb (C) will be in feet per minute if the plane weighs 2,000 pounds.

$$C = \frac{50 \times 33{,}000}{2{,}000} = 825 \text{ feet per minute.}$$

With the same graph, but using a speed of 100 m.p.h., the excess power is only 30 h.p. so that the climbing speed is reduced. Thus:

$$C = \frac{30 \times 33{,}000}{2{,}000} = 495 \text{ feet per minute.}$$

Now, with all of the conditions exactly as stated, this would be the climb obtained at the given horizontal speeds according to the principles of mechanics, but in actual work there would be a slight difference due to the fact that the engine output varies at different speeds and because of the fact that there are slight differences in the propeller efficiency at the two speeds which are not taken into account in the graph.

It is very evident, if the above calculations are studied, that the rate of climb depends upon the "power loading," that is, upon the weight carried per horsepower. Thus, a machine

(*Concluded on page 338*)

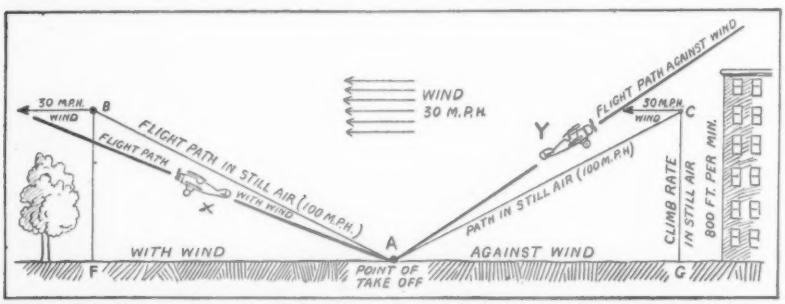


Fig. 5. This diagram shows why the airplane (Y) has a steeper ascent against the wind than the plane (X) has in the direction of the same 30 m.p.h. wind. The height (C-G) attained against the wind is greater than the height (B-F) when climbing with the wind.

Keeping Your Plane Ship-Shape

by F. NAGLE

Pertinent hints on how to keep your lightplane in proper flying condition after you have built it.

WELL, now that you fellows have finished building your ship, and have found out whether it flies O. K. or not, your task has just begun. You have to keep 'er flying, if you intend to get the full value out of your investment in your ship, and often this job is as difficult as building the ship in the first place.

Hangar rental usually averages around twenty-five or thirty dollars a month, and as most fellows have little time to fly except on Saturday afternoons or Sundays, the ship is usually kept at home. This necessitates carting the ship through the streets to the field and setting it up or rigging it before it can be flown. Attaching the wings to the ship and rigging the controls is a job that will eat up at least an hour and a half, so there is usually little time left for flying.

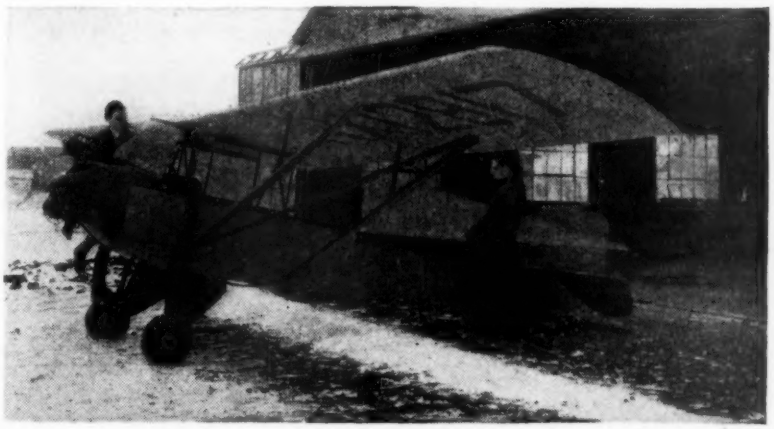
One remedy is to bring the ship to the field on Saturday afternoon, set her up, get in some flying and store her in the hangar for the night. This usually will set you back about a dollar. Then fly her on Sunday, take it down in the evening and bring her home.

This will save a takedown and a setup and it is well worth the cost of one night's storage. At some fields no objection is made against leaving ships parked outside the hangars and no charge is made for using the field, but take some good advice and don't leave your ship in the open. Tough weather is equally tough on your ship, and so are many airport visitors.

I well remember the case of a friend who left his ship out overnight and when we came around the following morning, found the ship in need of a lower left wing. It seems that some kids who lived near the field had been using the wing for a diving board, with disastrous results to the wing. There was little fabric left, and every rib was badly shattered. He learned his lesson and hangars his ship now.

If you find it undesirable to keep your ship in a hangar and wish to keep it at home, the best way to transport it to and from the field has been found to be the following. Get two pieces of stock, about two by three inches. Fasten one on the bottom near the front of the ship with about a foot or so projecting at either side, and do the same at the rear of the fuselage.

Pad the projecting ends thickly on the top and set the wings, one on each side, with the leading edges on the padding. Put padding between the bottom of the wings and the sides of the fuselage and then tie the wings to the fuselage with rope, being sure to pad the ropes where they rub against the wings or fuselage. It is more convenient to make up small pads of cotton and waste than to have to hunt for padding every time you want to transport your ship to the field.



Frequent and careful examinations of the lightplane is the only insurance of satisfactory performance and safety in flying.

It is a good idea to make an arm to tow the ship behind your car. This can be made out of a piece of tube with a clamp to fit the skid on one end and a hook to attach on the car at the opposite end. It will pay to incorporate a universal of some sort at the car end, or you will find the ship hard to tow around corners at fairly fast speed. And another thing that you should not forget—grease the wheels on the ship before you start for the field, and every few miles, if the tow is a long one, or the bearings will be shot to pieces in short time. A five mile tow is harder on the wheels than a day of short hops with the average landings, takeoffs, and taxying included.

And as to choice of fields from which to fly your lightship. Don't pick any meadow that presents itself, or on the other hand don't go looking for some congested airport. At a busy field the amateur places himself in a bad position on account of the traffic, which obliges him to be ever on the alert for collisions and to wait his turn to land and take off. Then, too, lightships do strange things if they get in the wash of a high powered crate that leaves miniature hurricanes in its path.

And another thing, pilots dread flying when there are a number of amateurs flying around, and you're sure to incur their wrath if you cut in on them when landing or commit any one of a thousand other amateur's mistakes. Rather it is better to pick some field where there is not much traffic, and where you can do what you like without displeasing another party. Pick a good smooth field that is not a mudhole if it rains, does not have many rough spots and has clear approaches. Here you can fly to your heart's content without wondering what to look for every time you take off or land, and can set your ship down without risking a crackup on account of bad ground.

Now that the hangar, transportation and field questions have been discussed, we now come to the matter of the flying and maintainance of the ship itself. First we'll take up the matter of your ship's engine.

For the most part lightships make use of converted motorcycle, automobile or marine engines and some homebuilt ships use regular aircraft engines. On account of the profusion of types, no particular engines will be taken up. First comes the matter of fuel. For best performance the aero grades of auto gas or the regular aircraft gasoline should be used to get the most out of your motor.

Aircraft gas is much more powerful, burns quicker and leaves less carbon than the regular grades of auto gas. High grade oil is essential if you want your motor to deliver maximum power and the best oil to use is either the highest grade of automobile or straight aircraft. Aircraft gas and oil cost more than motor car products, but the superior performance obtained from

their use more than justifies the slight extra expense.

You should keep a constant check on the condition of your motor, and have a system of regular inspections and checks. Every ten or fifteen hours, or sooner if possible, you should check the motor for the following—valve clearance, condition of valves, spark plugs, and the mags for spark and points, condition of carbureter and tightness of all nuts, bolts and motor bed.

It is a good idea to check the bearings and clean the carbon out of the cylinders together with an inspection of the oiling system as often as possible, or at least every twenty-five hours. Constant inspection insures safety, and it is well worth it.

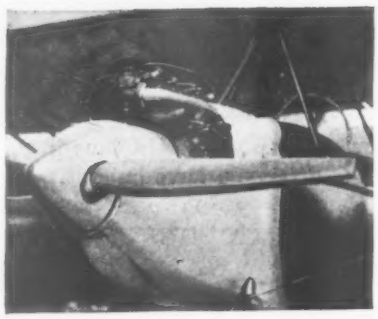
Before a flight, you should check your supply of gas and oil, check motor and prop for any damage, see that everything is o. k., and then you are ready to start the ship. Start by blocking the wheels. Turn on the gas, choke her and turn over the prop a few times by hand to draw gas into the cylinders. Be sure the switch is OFF. Do not flood the carbureter too much nor draw too much gas in. She might backfire and catch fire.

When you are ready to start, get her on compression, switch on, and pull her through. If she repeatedly fails to start, the cylinders will load up with raw gas and the engine should be turned over a few times backwards with the switch off. This will let most of the raw gas escape. Then the regular procedure of starting should be gone through again till she starts.

Once your engine starts, keep the throttle well back and the engine turning over slowly till the pressure comes up to normal, which should not take more than a minute or so, and the temperature of your oil also reaches its highest point. If the oil pressure fails to come up immediately, the motor should be shut off, and the oiling system looked over. When your pressure and temperature are normal, then is the time to rev the engine up and see if she gives her correct number of revs. If revs are o.k., oil pressure and temperature normal, and engine sounds o.k., you are ready to take the air.

When flying, never cut the switch off and on, or you are likely to blow a cylinder head or burst a cylinder, because the engine still sucks gas while the switch is off and you have an oversupply when the switch is cut in again. Keep check on your oil pressure, temperature and tachometer while in flight. If, she drops off in revs and you cannot determine the cause, it's best to land immediately before anything serious happens. If your oil pressure and temperature drops also, cut the switch if they do not pick up and land immediately.

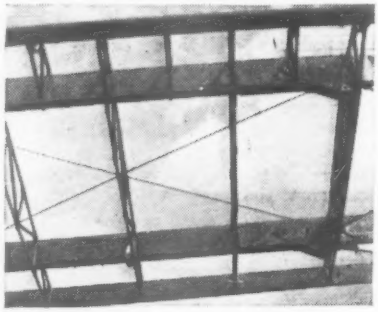
If the pressure drops, the oil is not forced to all parts, and there is much danger of the motor overheating and freezing up, which is enough to wreck



The power-plant requires more attention than any other part of the plane.

any motor. Still another thing, be sure that all oil lines and connections are tight, both to prevent the ship from being oil covered and to keep the motor from freezing up. Gas lines and tanks should be watched, for vibration will loosen up the tightest connections and open the tightest seams.

Gas leaks through places that water could not, so test your tanks with gas before they are installed in the ship. And speaking of precautions, it's a good idea to carry some sort of fire extinguisher, one of the pint or quart

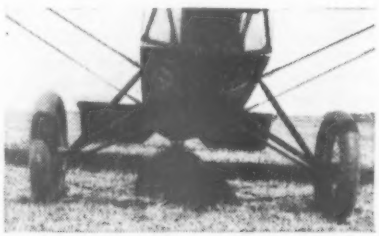


Even after a small crackup, the wing structure should be examined.

size, such as the Pyrene or Fire Fyter type. You may think that you will never have need of one but all fires come unannounced, and to be prepared is to play safe. Ships catch fire in the air, and if you are without an extinguisher it's usually just too bad. Carry one.

Now to take up the plane itself. The ship, exclusive of the motor, usually receives too little attention, except for the occasional wiping or polishing. Doing the right things by the motor, and nothing for the ship does not pay. The ship is just as important as the

(*Concluded on page* 344)



Landing gears are subject to heavy blows. Check up on them frequently.

An Interesting Submarine Model

IT HAS been a long time since the editors of P. A. have paddled around in bathtubs and fish ponds, but the model submarine sent to us by the Westlake Model Company, Erie, Pa., proved so intriguing that we could not resist the temptation.

This model is a scale reproduction of the U. S. Submarine S-50, all complete with conning tower, naval gun and trim. It is driven by a rubber band motor, both when on the surface of the water or when submerged beneath the surface. It can be adjusted to dive and will then return to the surface automatically in a very realistic manner.

When the sub is to dive from the surface, two adjustable fins near the bow are turned down, and then water ballast is admitted to the ballast chamber by opening a valve on the deck. After a short run on the surface, down she goes and remains down until the rubber motor is partly exhausted.

The sub then rises to the surface where it is easily captured and is then wound up for another trip. We got a lot of kick out of this model.

Pigeons Interfere With Planes

NOT only must pilots brave the elements and engine dangers, but the pilots who fly to and from the Detroit City Airport meet the additional hazard of battling flocks of pigeons who boldly attack the planes that are taking off and landing at the field.

The fool-hardy audacity of these usually tame birds results in ten to a dozen deaths daily. The pigeons strike against the planes, breaking through the wings, leaving large rents which must be repaired immediately. The pilot and passengers are at the mercy of the hapless birds who easily might break through a cabin window and injure a passenger or possibly break a vital part of the plane.

It might seem that after the death of twenty or thirty birds, the pigeons might become discouraged, but that is not the case. They come with greater numbers and greater fatalities. When the sound of a motor is heard on a take-off, the pigeons rise too and spread in all directions for the attack. For a landing plane, the birds wait until it is overhead then they rise and—some fall never to rise again.

Woman Flies as Air Mail

A BRAWNY California woman was properly addressed, stamped and put aboard a plane by the postmaster as a regular piece of air-mail destined for Mrs. Franklin D. Roosevelt. She carried a basket of canaloupes for the White House breakfast table and also an invitation to visit her city when Mrs. Roosevelt makes her intended flying trip to the Pacific Coast.

Instruments for Balloon Flights

BUZZERS, red lights and other similar devices gave Ward T. Van Orman, noted balloonist, much to do when he went aloft in the Gordon Bennett international balloon race at Chicago, Ill. The American balloonist said that it required the alertness of a locomotive engineer to watch the numerous devices in his instrument chest.

In fact, the new altitude instrument, which Van Orman introduced for use in lighter-than-air craft, operates much on the same principle as railway signals. For just as the engineer depends on the block lights, so did Van Orman set his delicate instrument to flash a series of warnings once a certain height had been reached. His craft carried the most complete instrument chest of any balloon entered in the big event. His kit also included several additional devices which were undergoing trial tests.

A new type of varimeter was the most interesting piece of the collection. This has been constructed to perform four distinct functions by the mere turn of a switch. For instance, when a valve is set in one position, the instrument serves as a statometer. In three other positions the instrument is capable of registering any instant changes as high as 533, 800 and 1,333 feet per minute. The new varimeter is said to be a decided change from the statascope used in normal balloon flights. The statascope records the differences in altitude by showing the expansion or contraction of air in a container upon a colored liquid in a U-shaped tube.

Another new instrument taken aloft by Van Orman was the alarm altimeter, with a buzzer attached. This is a relief to a pilot in long flights, because he merely sets the alarm for a certain altitude, and thus is free to devote his attention to the other instruments. In case the buzzer becomes annoying or if the pilot's nerves are on edge, he may substitute a red light for the buzzer.

Another instrument, the incremeter, indicates an even smaller change in altitude. This is of extreme importance because the initial differences of height are sometimes very slow, and may be easily counteracted with a minimum waste of ballast or gas. For as the ascent or descent is accelerated, more gas or ballast is required to correct the condition. Consequently the flight is shortened.

In tests, the incremeter showed changes as little as 10 feet. The instrument consists of an air container with a top of goldbeater's skin, which responds instantly to the expansion or contraction of the air, thus making a series of electric contacts to the buzzer alarm and red light.

Thus, while we ordinarily think of a balloon as being the simplest possible device it requires complicated controls.

The Long and Short of It in Aviation

The Circus freaks have taken an outing at Mr. Corben's airport in Madison, Wis. The host is in the center with Harry Earl on the wing and Jack Earl at the right.

OUR friend, O. G. Corben of the Corben Sport Plane Co., Madison, Wis., has sent us this interesting photograph of the Baby Ace on circus day at the Madison, Wis., airport.

It all goes to show that both the tall and the short are interested in aviation, through all sizes ranging from a 28-inch midget to an 8-foot 6-inch giant. After the performance, the midget and giant strolled over to the airport and gave the Baby Ace what is technically known as the "Double-O.".

Harry Earl the midget, probably would be more at home in the Model Department than in the lightplane division. On the other hand, Jack Earl the giant, would be a rather tight fit in a commercial transport. Then we have, O. G. Corben standing between them who is representative of the average fan in stature.

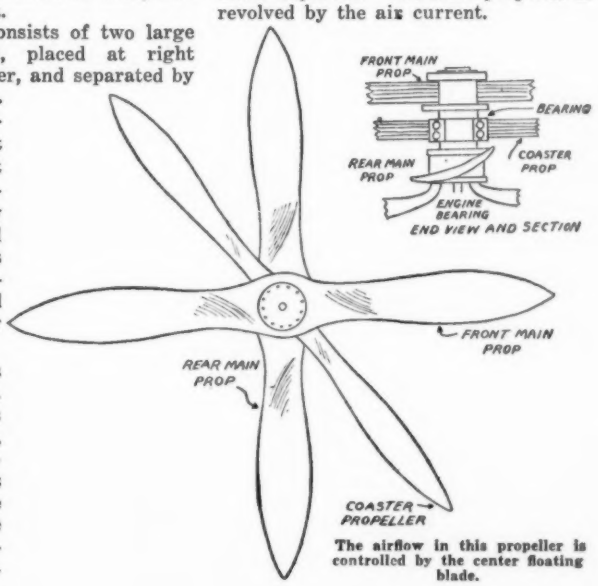
Please notice the sign which O. G. C. has had painted on the side of the fuselage—"Read POPULAR AVIATION." This nifty monoplane—and the sign—attract much attention.

A Three-Blade Coaster Propeller

A VERY peculiar propeller, at least when compared to conventional standards, has been designed by Louis G. Peeters, 840 N. La Brea Ave., Los Angeles, California.

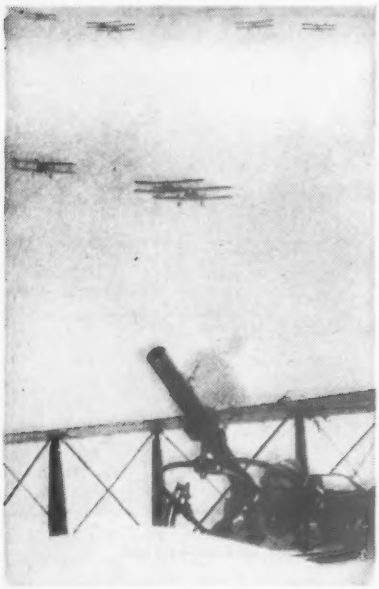
Essentially, it consists of two large "main" propellers, placed at right angles to each other, and separated by a short distance. These two propellers are keyed tight to the engine shaft in the usual manner. In effect, they form a four bladed propeller which is subject to the difficulties experienced with tandem four blade props.

To avoid this propeller loss, Mr. Peeters introduces a third propeller, or "coasting propeller," that turns loosely upon the shaft between the two main propellers. This, according to the inventor, redistributes the air-stream in such a way that the efficiency of the main propellers is very much improved. The loose propeller is revolved by the air current.



The airflow in this propeller is controlled by the center floating blade.

A Japanese Gunner at Work



A rare snapshot of a Japanese gunner in action over Manchuria. Wonder if he brought it down?

THIS is a closeup taken of a Japanese machine gunner in the rear cockpit of a Japanese bomber near Shanghai, China. Above him are the other bombers of the formation advancing on an important mission.

Flyers Who Make the Grade

QUERIES are often received as to what percentage of students entering flying schools possess the inherent ability to fly and succeed in passing the necessary requirements for the rating of a military pilot.

The little monthly class paper issued by the Flying Cadets at the Air Corps Training Center publishes some very interesting statistics on this subject. These statistics deal only with students entering the Primary Flying School at Randolph Field, Texas, and graduating therefrom to the Advanced Flying School at Kelly Field, Texas. Generally speaking, after a student is transferred to the Advanced Flying School he may be counted on successfully completing the advanced course. The exceptions to this rule are comparatively few.

Taking the class, including officers, flying cadets, noncommissioned officers training in grade, and students from foreign countries which began training at Randolph Field in November, 1931, the figures show that 48.80% of those who started training were transferred to the Advanced Stage. The percentage of successful students for the class of March, 1932, was 48.47; for the class of July, 1932, 48.67, and for the class of October, 1932, 45.10, or a general average for these four classes of 47.76%. The ability of the average American youth to make the grade is about 50-50.

QUESTION AND ANSWER DEPARTMENT

All questions of general interest on any phase of aviation will be answered authoritatively by POPULAR AVIATION'S Technical Staff.

QUESTION:—Jas. L. Coyne, Milwaukee, Wis. *Do you believe that any propulsive force would be exerted by the exhaust stacks of an aero engine if these jets of gas were directed toward the rear of the plane in a horizontal direction?*

Answer:—UNDOUBTEDLY, there would be some propulsive effect from the exhaust jets, particularly if they were carried outside of the propeller slipstream. Just how great this reaction would be is difficult to estimate, possibly only a few pounds, but it would help by just that amount.

* * *

QUESTION:—Ambrose L. Clayton, Nashville, Tenn. *I have heard it said that the chain-driven double propellers of the early Wright biplanes were very efficient. If this is true, why should this be so?*

Answer:—COMPARED to the standards of that time, the double Wright propellers were very efficient because their top speed was quite low and the blades were well formed. However, when compared to the highly developed present day propeller, they would not make such a good showing. The chain drive was troublesome and consumed some of the power that should have gone to the blades.

* * *

QUESTION:—K. L. Brendt, Nashua, N. H. *Do you believe that coal can be used as a fuel for airplanes when the proper engine is developed for burning it?*

Answer:—NO. In the first place, coal is much heavier than gasoline for the amount of thermal energy that it contains. A pound of very good coal only contains 14,500 b t.u. at the best, while a pound of gasoline contains approximately 50 per cent more heat energy, or about 21,000 b.t.u.

* * *

QUESTION:—L. Eisenberg, Indianapolis, Ind. *What is a "binary" aviation engine? Are there any in use?*

Answer:—A BINARY heat engine is an engine that employs two working fluids. Thus, if the exhaust steam of a steam engine were used to heat ether until it established a pressure, and if the vaporized ether were used in the cylinders of a second engine, then we would have a binary heat engine. Many have been proposed and experimented with, but none are at use in aviation at the present time to our knowledge.

* * *

QUESTION:—Earl L. Thorpe, Muskegon, Mich. *In many books I find the constant or coefficient "375" in formulae used for calculating horsepower. How is 375 derived?*

Answer:—THIS figure results when feet-per-minute are converted into miles-per-hour (60 x 5,280) and then when 33,000 foot-pounds per minute are converted into pounds-per-mile-per-hour. After cancelling these products, this gives 375.

* * *

QUESTION:—Joseph D. Shepherd, Minneapolis, Minn. *Will oiling the wings and other surfaces of an airplane reduce its resistance in flight? If not, why not?*

Answer:—EXPERIMENTS show that lubrication gives only a very slight improvement because the greater part of the total resistance is due to eddies and turbulence set up in the air and not to the air rubbing along the surfaces. Because of the viscosity of the air, that causes the air to cling tenaciously to a surface, there would not be much rubbing on the surface because of the low velocity.

* * *

QUESTION:—Arthur Bevans, Chicago, Ill. *Do streamline wires very materially decrease the resistance when compared to ordinary round stay wires?*

Answer:—WHEN held with its sectional axis parallel to the air-stream, the resistance of a streamlined wire is very much lower than that of a round wire, but when such a streamlined wire is only a little out of the proper position, the resistance jumps up very quickly. And again, there is quite a bit of flutter with the wire in the position of least resistance, and to reduce flutter means that the wire must be turned around so that it is no longer at its optimum point.

* * *

QUESTION:—*Please define the "center of pressure" and the "center of gravity." These points are not quite clear to me as I have never studied mechanics.*

Answer:—THE center of pressure is that point at which the sum of all the pressures on the surface act collectively. In other words, a single force applied at the center of pressure will be equivalent to the sum of all the individual pressures.

Likewise, the center of gravity is the point about which all of the weight elements in the body balance. A force applied at the center of gravity will produce the same effect as all of the individual weights taken collectively.

When the center of gravity lies upon or is coincident with the center of pressure, then the body is in equilibrium. When the C. G. is offset from the C. P., a turning moment exists that tends to cause rotation.

Practical Lessons in Aviation

by JOHN B. RATHBUN

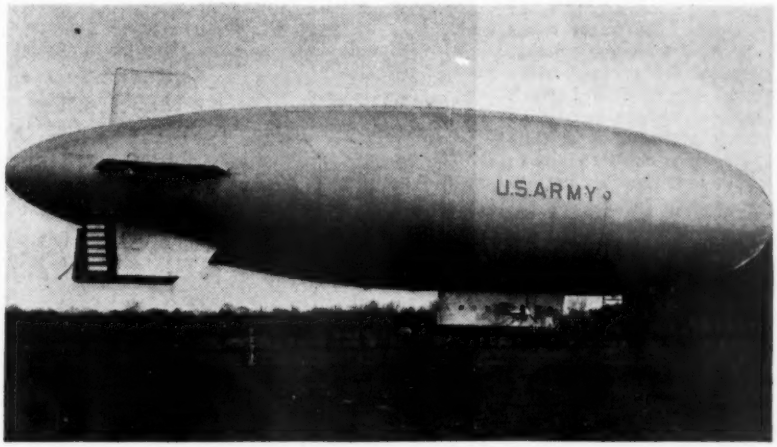
As the immediate successor of the balloon we have the dirigible in which the major portion of the lift is by buoyancy while forward motion and a certain portion of the maneuverability are provided by the engines.

NOW, while the spherical balloon was the first operative device for aerial transport, it was far from being a satisfactory means of locomotion. Having no means of propulsion horizontally it was more or less at the mercy of the winds and was controllable only to a limited degree.

For practical service, therefore, it was necessary to provide the balloon with an engine of some sort so that it could be propelled against the wind and so that it could be steered accurately in the desired direction. Its spherical form, however, did not lend itself readily to propulsion or steering, for the sphere presented a great amount of resistance when forced through the air.

When power was finally applied to the balloon, its spherical form was altered and it gradually assumed the long slender cigar-like shape of the present dirigibles, or more properly—airships. By distributing the gas in this way, the area presented to the air during propulsion was greatly reduced for the same amount of lift, thus reducing the size of the engines and the cost of operation. The elongated envelope or "hull" was provided with the necessary rudders for steering in the desired horizontal direction together with adjustable elevator flaps for controlling the upward and downward course (within limits).

Now, at this point, there comes a certain dissimilarity between the lifting forces utilized in spherical balloons and dirigible balloons or airships. In the case of the spherical balloon, all of the lifting force or support is produced by the buoyancy of the gas as already explained. In the case of the dirigible, the greater part of the load is still carried by the buoyancy of the gas, but a part is also sometimes carried by the pressure of the air rushing under the hull when the ship is moving forward. This force, due to the impact pressure of moving air against the surface is known as an "aerodynamic force" which is similar to the lifting force applied to the wings of an airplane.

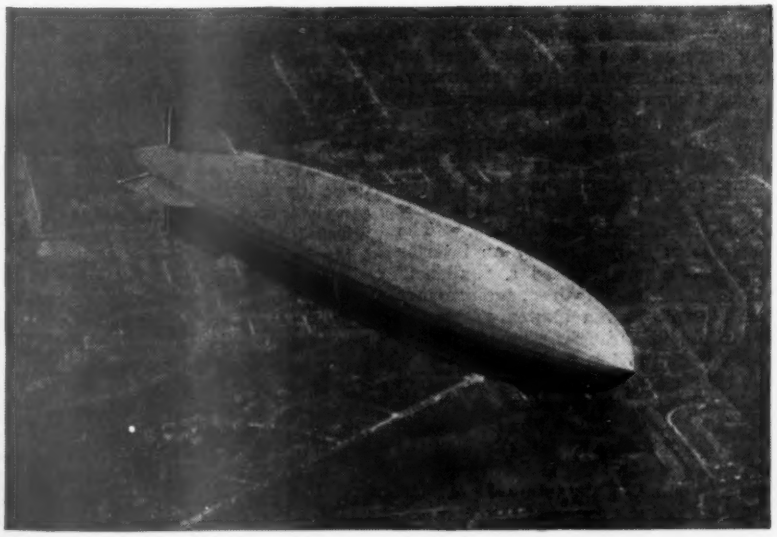


An example of a non-rigid dirigible or airship in which the fabric provides the necessary structural strength. Note the streamline form of the hull.

Thus, an airship can be made to float in equilibrium at any point in the air by suitable adjustments of the gas and ballast, just like a spherical balloon, but when it is driven forward by its engines, it can be made to rise or fall to a limited extent by the impact of the air against its hull and adjustable horizontal elevator surfaces. This method makes the ship more easily maneuverable than by gas and ballast adjustments, and further, there is no waste of gas or ballast when the forward motion is applied to lifting or depressing the altitude of the ship. When a great increase in altitude is necessary, then this method alone is no longer applicable and some ballast must be discharged.

To increase the altitude of a spherical balloon, it is lightened by discharging a quantity of the ballast in the form of sand or lead shot. If the altitude is to be decreased, then some of the gas must be allowed to escape through the maneuver valve on top of the bag. This loss of gas and ballast during maneuvering finally brings the balloon to earth even though there is no leakage.

In the practical airship, however, several very ingenious methods are employed for conserving the gas so that an airship can cruise for many thousands of miles or remain in the air for many days with very little loss of the valuable gas. The employment of internal combustion engines makes this possible with the airship for the en-



The U. S. S. Akron, one of the largest and best known examples of a rigid type airship. The loads are carried by an internal metal trussing system that also provides the streamline form of the hull.

gines can be made to manufacture ballast while the ship is in the air. Thus, in the practical airship, extreme changes of altitude can be made by leaving the gas volume constant (no valving) and by increasing or diminishing the amount of the ballast.

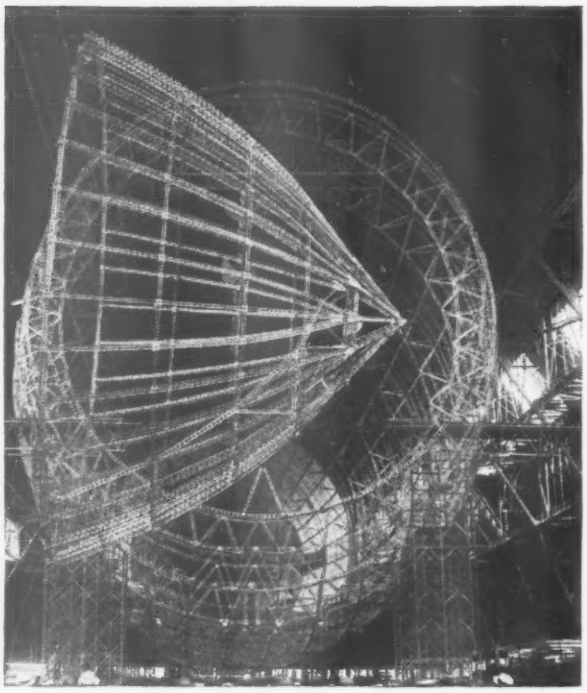
Water ballast is largely employed in airships of large size, the water being condensed from the exhaust gases of the engines. One pound of gasoline burned, produces approximately 6.5 pounds of water vapor thus the engines can be made to create counter ballast to compensate for the weight of the gasoline consumed while in flight, and the gas lost from the envelope. In the Graf Zeppelin, blau gas is used for a fuel instead of gasoline, and as this gas is slightly heavier than air, there is no effective change in weight when the gas is burned and hence no need for ballast adjustment.

Gasoline is a chemical compound known as a "hydrocarbon" that consists of combined carbon and hydrogen. When the hydrogen component burns, it combines with the oxygen of the air to form the familiar H^2O or water, hence the additional weight gained by combustion is actually the weight of the oxygen taken from the air for burning the gasoline.

Thus, by careful management of the ballast alone and also by the employment of aerodynamic lift for maneuvering, it is not necessary to lose any more gas than that amount lost by osmosis through the envelope or by actual leakage. Repeated trans-Atlantic flights of 4,000 miles have been made, while the Graf Zeppelin has flown clear around the earth (25,400 miles) without replenishing its gas.

It is hardly necessary to state that the structural arrangement of an airship is far more complicated than that of a balloon. In the spherical balloon, the buoyancy of the gas produces simple tension stresses in the envelope which requires no bracing of any sort outside of the strength of the fabric itself. The sphere is the ideal form from a structural standpoint, as it is the lightest possible shape to build and presents the least diffusion surface.

When the hull is elongated, as with the airship, bending stresses are involved and further, the pressure of the air on the nose of the airship caused by its forward motion tends to crumple the hull so that it must be braced in some manner. The various methods of stiffening the hull of an airship, divide them into three principle classes as follows:



A view of the complex structural members of the rigid dirigible, the U. S. S. Macon. The nose piece is just being hoisted into place.

1. NON-RIGID or PRESSURE airships, now made in the smaller sizes known as "blimps." No bracing is used.

2. SEMI-RIGID airships have only a single simple keel brace at the bottom of the ship.

3. RIGID AIRSHIPS contain an elaborate interior skeleton framework like that of the Zeppelins and the gas containers are independent of the outer skin.

Beginning with the simplest type, the "non-rigid," we find an elongated hull completely filled with gas, the outer envelope of the ship retaining the gas just like the envelope of the spherical balloon. There is no solid bracing of any sort so that the outer envelope carries and resists all of the stresses imposed upon it by the loading and air pressure on the nose.

In this case, the outer envelope is stiffened by maintaining the gas at a considerable pressure above that of the atmosphere, hence the type is also known as a "pressure airship." The pressure is maintained by an interior balloon (or bag) called a "ballonet" which is filled with air under pressure by a power driven blower or by the air taken in through a "scoop" when the ship is moving forward. Usually, the blower is only in use when the ship is standing still in the air or is moored to the ground. The motion of the ship generally forces sufficient air into the scoop when the ship is traveling forward to maintain the internal pressure.

There are decided limits to the size of a non-rigid dirigible, hence only the smaller blimps and airships are built in this way, and further, the speed is also limited. When we get up into the larger sizes, the stresses in the envelope would be so high that an excessively heavy fabric would be required hence a framework would prove lighter and more effective. The pressure must be sufficient to maintain a perfect streamline form without billows or flabbiness.

And next, comes the second class, the so-called "semi-rigid" which is nothing more than a reinforced non-rigid built for medium size service. The outer envelope may retain the gas as before, or the gas may be stored in a number of internal gas bags, but a long structural member running lengthwise of the hull (generally at the bottom), stiffens the ship against bending stresses. Semi-rigid airships are built in the medium sizes, but with the exception of the Italian airships, they are seldom used.

Just at this point we might mention an intermediate type, the "Tri-lobe" which is partly non-rigid and partly semi-rigid. In this ship there are three complete and independent hulls bound together in such a way that they form a truss system among themselves and are stiffened by the gas pressure. The Tri-lobe is quite strong and can be built in larger sizes than the non-rigid.

Finally, we have the full "rigid" type with its elaborate interior metal trussing which is built in the largest sizes. The Zeppelins are of this type. The members of the frame are of duralumin or similar light aluminum alloy although in the earlier ships, the structural members were frequently of wood. This frame, beside carrying the load, also carries the outer skin which, in this case, is only used for streamlining the ship and not for carrying gas as with the non-rigid and semi-rigid types. The heavy "longitudinal" girders run fore and aft and are held in place by annular ring girders. The complete bracing system is very complicated but for its strength is exceedingly light.

The gas is carried in a series of independent flabby gas bags or "cells" placed within the girders, which may be either hydrogen or helium gas. The latter gas is used on the dirigibles of the U. S. Navy for the reason that it is non-explosive and therefore permits of enclosing the engines within the hull. These gas bags are of such number (12 in the Akron), that several of them can be punctured or disabled without causing the ship to sink. The cells are usually filled to 95 per cent.

(*Continued on page* 335)

Making a Propeller In the Wilds

IN THE summer of 1919, the Imperial Oil Company, drilling at Fort Norman in the Arctic Circle, struck oil. Two J. A. L. (Junkers) monoplanes were sent in with engineers and supplies.

In those days there were no gas caches and no means of getting gasoline into the Fort for the return trip. That did not phase these intrepid pioneers. Sufficient gas was distilled from the oil at the wells. This in itself was an achievement but it pales into nothingness compared to the greatest task which faced these men.

In landing at the Fort, one of the planes shattered its propeller. There were no replacements nearer than New York City and it was impossible to obtain a new one without considerable difficulty. The pilots, assisted by a woodworker living at the wells, decided to manufacture one.

Making a propeller of wood is a ticklish proposition at any time, the greatest care being necessary in the selection of materials and in finishing the blades. To attempt to make one with practically nothing, which would have to carry them more than seven hundred miles, speaks volumes for the confidence these men had in their own ability.

They first selected a few logs of clear birch. These, they sawed into the required dimensions. After four days of arduous toil they succeeded in making nine planks, one and a quarter inch thick, ten inches wide, and nine feet long. They now laid these aside to dry.

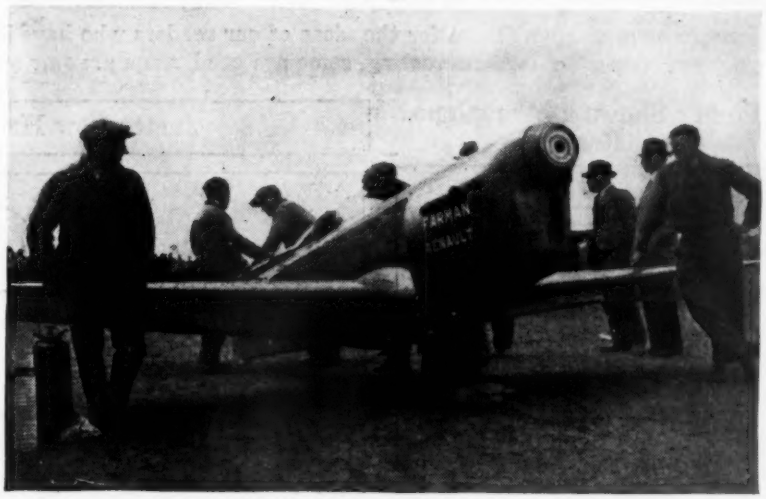
Two moose were shot and from their hides and hoofs they succeeded in boiling down enough glue for their purposes. Many more days were spent in planing and smoothing the planks, but with plenty of glue and wooden pegs they soon had a very presentable propeller blank.

Starting at the hub, they cut out the holes for the boss. Using the remnants of the old "prop" for a pattern they planed, cut and smoothed away until the finished product was ready for the test.

As the big motor burst into a husky roar, the whirling "stick" was watched with anxious eyes. There was no vibration and the heaving and tugging on the anchor lines proved that the efficiency was equal to that of a factory made product.

The old barnstormers and gypsy flyers have told stories of flying haywire crates. They have told of coming home with the main spars patched with anything they could find, but it is doubtful if ever yet has there been a more convincing demonstration of the capabilities of the pioneers than that recorded in these paragraphs. Their resourcefulness is typical of the intrepid breed of men, those winged couriers who guide the spirit of enterprise over the uncharted wastes of the upper air.

Farman Produces a Mono-Wheel Speedster



The Farman Monoped is a particularly clean looking ship when viewed in the direction of the air stream.

THE Farman airplane factory in France has taken a leaf out of the experience of hedgehopper builders in the U. S. A. and has produced a low-wing monoplane of the single wheel type.

It is claimed that there is a distinct saving in both the weight and the parasitic resistance by this method and that the performance is remarkably improved by the elimination of the commonly used two-wheel landing gear. The wheel is shrouded by a suitable casing with a curved tube radiator at the nose of the shroud.

Rubber sprung sprags at the wing-tips hold the machine level when standing on the ground, and when the ship is in flight, the sprags are drawn up flush with the under surface of the wings so that they present very little resistance. No data has yet been given out on the performance of the plane, but it would seem that every horsepower would be capable of doing its duty with such an arrangement.

Here Are the Details of the Piccard Gondola

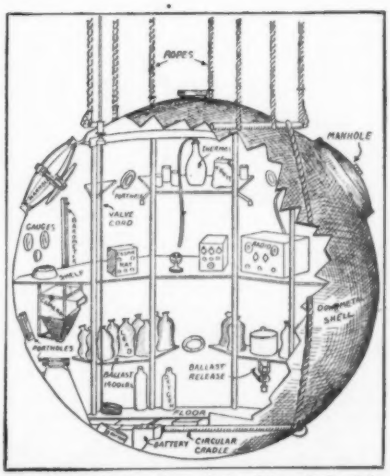
IN THE accompanying sketch is shown a cross-sectional view of the gondola in which Dr. Jean Piccard and Lieut. T. G. W. Settle plan their next balloon flight into the stratosphere.

Because of the small space permitted in this gondola, great care was necessary in arranging the equipment.

Resting on the floor are the oxygen flasks which supply the necessary gas to the occupants while at high altitudes. Just above the flasks, to the left, are the ballast storage bags containing 1,400 pounds of lead shot used for the control of altitude. Lead shot is used in place of the more usual sand ballast because of its greater compactness. At the right is a very accurate ballast release device for controlling the discharge of the shot.

On the second shelf, at elbow height, are the radio receiver and transmitter by which communication will be maintained with the ground station and also the instrument employed for measuring the intensity of the cosmic rays in the stratosphere. Then, there are the usual barometer, gauges and other instruments used for making atmospheric measurements. At the left and just below the second shelf, is a large camera which is directed through a peephole in the bottom of the sphere.

And now we come to the commissary department on the top shelf where the eatables are stored for the long trip. Yes, it is a tight fit for two grown men.

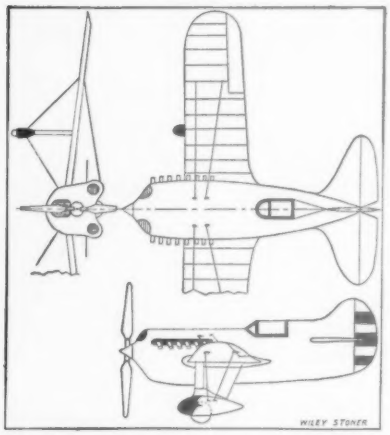


Detailed interior view of the Piccard Gondola.

Dream Ships by Our Dreamers

Here we have an open forum for the ideas of our readers who have been bitten by the designing bug. All are interesting, some are good, some are fair and some are—

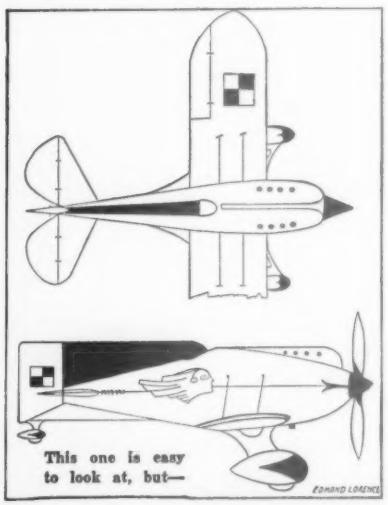
Stoner Shows a Monoplane Racer



WILEY STONER believes in going the Gee-Bee one better by putting the landing gear struts way out in the middle of the wing. And he has omitted one member in the landing gear system that is important when he comes down "bam." Well, where is this member?

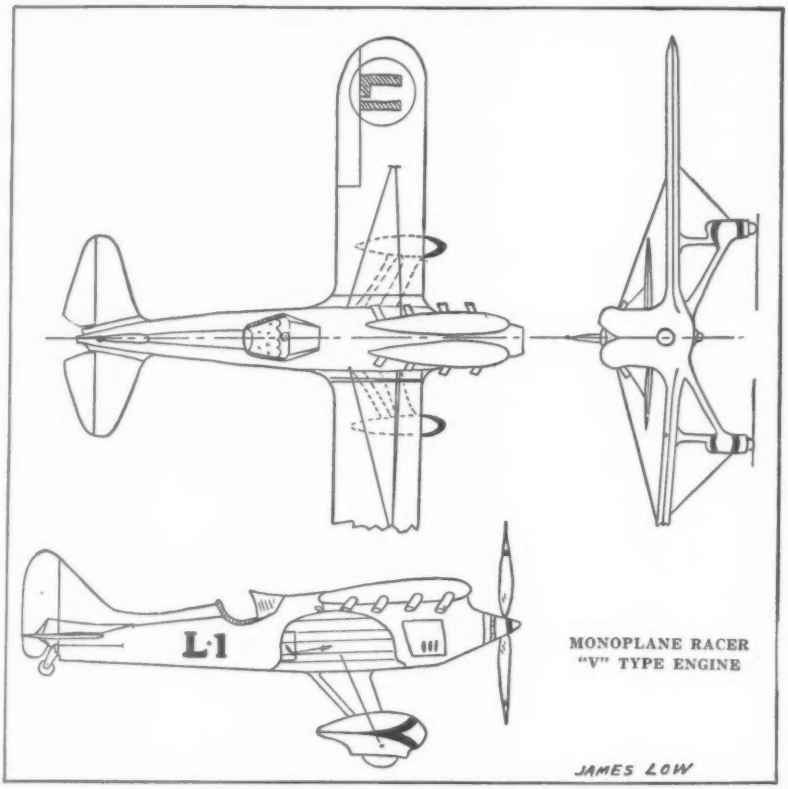
The Lorence Racer

EDMUND Lorence, 26 E. Sumner Ave., Roselle Park, N. J., tossed on the pillows when he dreamed of the P-13 racing plane pictured here. Please observe the pants and spats on the tailwheel which are the acme of consistency. Just what results would be obtained with the tremendous vertical fin is difficult to say, but maneuverability would not be one of the most noticeable characteristics. Edmund, who is 15 years old has engineering aspirations.



This one is easy to look at, but—

James Low Has a Unique Design



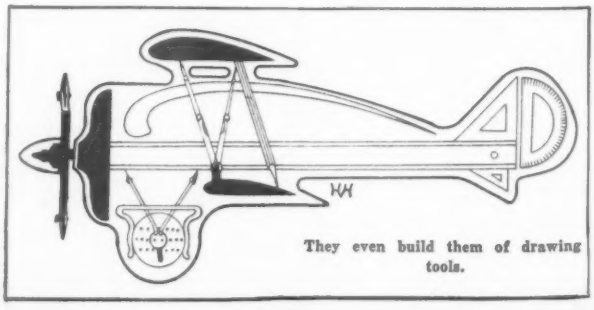
MONOPLANE RACER
"V" TYPE ENGINE

JAMES LOW, 8131 Keating Ave., Niles Center, Ill., has had his sleeping hours interrupted by visions of a hot looking low-wing monoplane racer which is pictured here. Everything on it is O.K. by us, but the rear of the fuselage and the tail-group are rather reminiscent of the old Jenny parts that correspond to the after portions of Mr. Low's hypothetical conclusions.

This One is Made of Draftsman's Tools

WHILE not really a dream ship in the strictest sense of the word, yet this design of a ship more or less approaches that ideal.

Looking closely you will see that this ship is built up of familiar draftsman's tools. The cowl and longerons are formed by the "T" square, the tail by two triangles and a protractor and the propeller by two ruling pens placed end to end. The turtle back is an irregular curve while the landing gear struts are the legs of a compass.



They even build them of drawing tools.

Details of the Knight-Twister

by VERNON W. PAYNE

The fuselage details of the "vest-pocket pursuit ship" are given here in response to many requests for the data. The stresses and sizes of materials have been worked out with great care.

THERE have been so many inquiries for further details on the vest-pocket pursuit ship, called the "Knight Twister," that I have laid out the drawings for the fuselage structure in such form that they can be presented in magazine form. It will be remembered that the general outline drawings for this little biplane were run in the July issue of POPULAR AVIATION, together with general data on the dimensions and performance.

During the past year, there has been much activity with miniature low-powered racers of this general type and the boys who have been fortunate enough to own them have been cleaning up good money at the various races and air-meets around the country. There is no doubt but what the miniature planes will be still more popular in the future for they make a great hit with everyone who sees them.

Now to get back to the subject of the fuselage for the "Knight Twister" which is a steel tube welded type with wood fairing strips to maintain the required circular sectional form. The turtle back consists of plywood supported on spruce fairing strips as shown. The section is circular at all stations which is very attractive and presents as nice an appearance as a monocoque fuselage.

The fairing of the fuselage sides is carried out on the rudder, making the fuselage wide at this point so that a stronger connection is possible for the stabilizer than would be the case without the fairing. This is very important for safety.

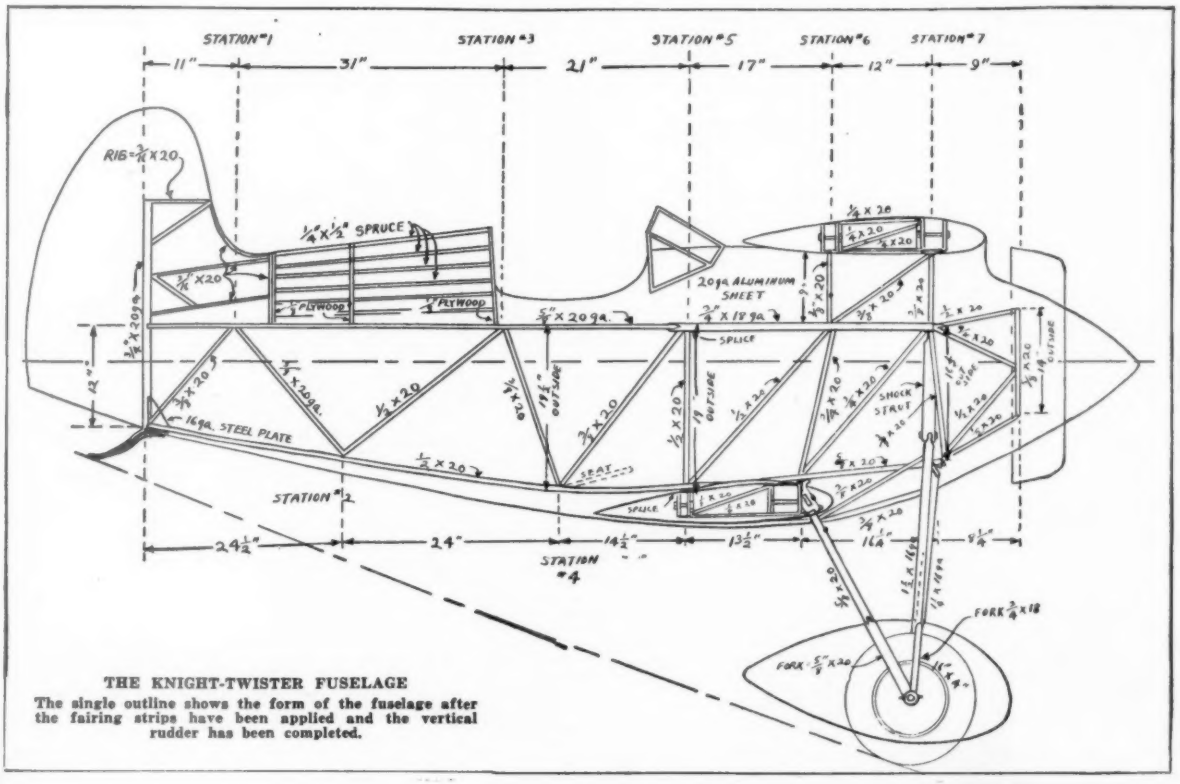
Now, many of you, after examining the accompanying drawings, will remark that it seems too heavy and unnecessarily strong for this size of ship —at least in places. However, in reply to this criticism, I wish to call your attention to the requirements of the Department of Commerce in respect to welded tubing. They consider that the strength of the tubing after welding is only 80 per cent of the original strength, and again, that it is a good idea to have 20 per cent additional strength as a safety factor against weak welds and softened material.

Our ship is designed with a load factor of 6.5, but after adding 20 per cent to make up for loss in strength due to the welding and then 20 per cent more for safety, it is almost the same thing as designing with a load factor of 8.5. Even with these large factors, the tubing could be made smaller than shown but we must also consider the stresses encountered when handling the ship at the airport. Handling often produces stresses in excess of the landing or flying stresses.

While the drawings do not show the actual fairing strips, the outline of the faired body is shown here so that the fairing can be applied to attain this form. The strips must be close enough together to insure a smooth application of the fabric or plywood without bagging or pockets, for any unevenness of this sort will most certainly increase the resistance and will correspondingly reduce the speed.

Usually, the sides are built first by drawing the outlines on the floor or some similar flat surface. A "jig" can then be erected for holding the parts in place. Write the size of the tubing with chalk on this drawing and then nail cleats or small blocks of wood (½" x 2" x3") along the lines in locations proper for holding the tubing in place while tack-welding. To protect the floor from burning, slip a 16 gauge steel sheet between the floor and the welded joints.

All tubes should be well fitted to-



THE KNIGHT-TWISTER FUSELAGE

The single outline shows the form of the fuselage after the fairing strips have been applied and the vertical rudder has been completed.

gether, so that there will be no large gaps to be filled with welding material. If too much metal is used for making the weld, it will cause excessive shrinkage when cooling and may distort the frame or even pull it apart when cold. Crinkled tubing is generally due to this fault.

The longerons are spliced with a "fish-mouth" splice, cut to an angle of 30 degrees. The smaller tube is slipped into the larger tube by at least 4-inches according to regulations, and welding should be done by moving the torch toward the larger tube. If the large tube end is welded first, we are likely to anneal the small tube more than necessary. The engine mount is welded to the fuselage after the fuselage is completed.

Build the two sides of the fuselage in the jig as described, but without the engine mount or the tail-post. If the tail-post is put in at this time it will be impossible to square up the members and the engine mount will also interfere with making the alignment. After the two sides are tack-welded, they can be laid on a couple of saw-horses and then the joints can be completely welded. The longerons of this ship are straight so that the fuselage can be made in a jig having a flat surface for the longerons to rest on. In this way, the fuselage is built "bottom-side-up" in the jig.

Some of the boys use a sort of scaffolding for a jig to hold the pieces straight while the cross-tubes are being cut, fitted and tack welded. I have also seen fuselage members assembled without any jig at all, but this makes it difficult to keep the job square while proceeding from station to station.

When building, with the floor as the flat surface of the jig, first draw a straight line with chalk to represent the centerline of the top truss. This is nearest the floor. Now draw the top truss members on the floor, keeping the centerline in the center. Draw lines where the diagonal tubes are to go, marking the sizes with the chalk. Next, nail some cleats around the lines to locate the tubes when they are cut and ready.

The bottom truss, which includes the bottom longerons, has a few bends in the sides and must be held at or near each joint by scaffolding. This scaffold is built up the sides and then tied over the top of the fuselage. The "top" in this case is the top of the assembly job which is in reality the bottom of the fuselage when it is in flying position.

One way to build the scaffolding is to use 1" x 4" lumber for the side scaffolding and a piece of steel angle iron across the top of the jig at each station. Notches are cut in the angle irons where the longerons pass through and the angles are bolted to the 1" x 4" wood uprights. This is so that they can be removed and the fuselage lifted out of the jig when it is completely tack-welded.

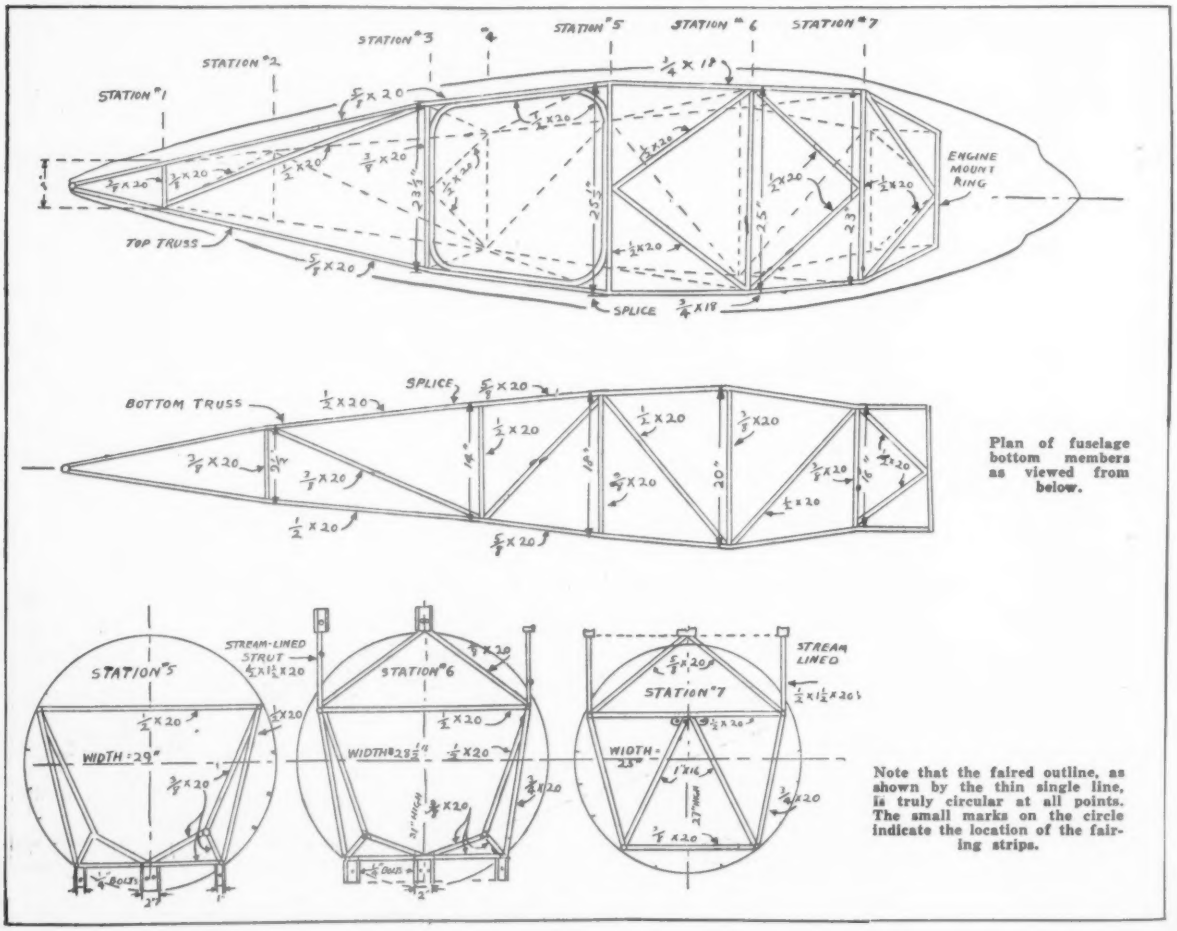
The 1" x 4" wood uprights are at each joint on the bottom truss, but are not close enough to touch the tubing so that they will be burnt while you are using the torch in welding. The uprights have to be braced outward from the sides as well as forward and back.

Leave the diagonal tubes to be put in last. Put in the cross-tubes first and tack weld. Now we must check our jig and that part of the fuselage now built, to see if it is square, before welding in the diagonals and internal bracing.

With a ruler and chalk, mark on the cross tubes the exact center of the fuselage, measured across the fuselage from side to side. The centerlines of the cross tubes of top truss, which is nearest the floor, should be directly over that chalked centerline we made on the floor at the beginning.

Now, if the cross-tubes in the lower truss, which is near the top of the jig, have not their centerlines above that

(*Concluded on page* 330)



Plan of fuselage bottom members as viewed from below.

Note that the faired outline, as shown by the thin single line, is truly circular at all points. The small marks on the circle indicate the location of the fairing strips.

What Our Readers are Building

A department devoted to our readers' activities in airplane, glider and engine construction, showing the latest developments.

A Minnesota Glider Club is Formed

IN JANUARY of 1932, a partnership was formed at Austin, Minnesota. The members were Miles Vandegrift, an airplane pilot and mechanic; John Vasey and Richard Riedel, glider enthusiasts.

The general purpose of this group was to design and construct a new and better primary glider. The partnership had little engineering knowledge, but had experience in practical airplane design and construction.

On June 25, 1932, the V. R. V. One, was test flown by Mr. Vandegrift. Since that time it has proven itself to be the safest, best performing glider in the primary class. In the last four months it has made five hundred flights in all kinds of weather, in winds of thirty mile velocity, in rain, snow and sleet. Its flying qualities have been praised by every glider and power plane pilot who has flown it or seen it in the air. The specifications of the V. R. V. One, are as follows:

Span	36′ 6″
Cord	5′
Overall length	19′ 6″
Wing Section	Durand 24
Weight Empty	138 Pounds

The wing is built up of spruce spars and ribs, the spars being of the "U" beam type. The fuselage, elevators and rudder are of welded steel tube construction. Foot pedals are used in place of the usual rudder bar in order to avoid "sled" turns by students. The landing skid is built of heavy gauge tubing and is equipped with a wood runner, the latter being easily and quickly replaced when worn. Wing tips have shock absorbing skids.

To readers who believe 138 pounds is too light for strength with a ship of 36½ foot span, I point to the tests to which the glider has been subjected. It has been towed by auto at an air speed of 60 m. p. h., for ⅜ mile.

It has been dived repeatedly at angles near the vertical and has often been put through wing-overs and split "S" turns. The ship came through all of these tests without a sign of strain. It has also been through many pancake landings by students and power plane pilots.

This glider has shown no tendency to spin, no matter what position it is stalled in. It has a gliding angle that compares favorably with a popular secondary ship. Five 360 degree turns can be made from 500 feet with a return to the starting point. It will climb to the limit of a 1000 towline with an auto run of 1500 feet.

Glen Smith Shows 'em How to Do It

This is the attractive monoplane built by Glen A. Smith that is Powered with one of Henry Ford's little pets.

GLEN A. SMITH, Mason City, Ia., has designed and built a hot looking little monoplane. It was originally designed for a Continental A-40, but because of the depression it is now loaded and armed with a Model A Ford engine of which you have all heard.

It has a 25′-0″ span, 45″ chord and a length of 15′-10″. Fully loaded, it weighs 780 pounds. Our contributor says that he can give us no definite figures on its performance because it had a slight crack-up during the early stages of test-hopping. Mr. Smith also tells us that as soon as repairs are completed that he will continue his one-man flying school until he can loop and everything.

Elmer Smith and His Biplane

WE HAVE had so many requests for a close-up view of Elmer Smith's biplane that we have decided to comply with the request although this same ship was shown in flight in the September issue. This enlarged view reveals many details that were not apparent in the flight picture.

Powered with a Salmson A.D.9 engine, it has a top speed of about 90 m.p.h. and cruises at 70 m.p.h. The span of the upper wing is 22 feet 6 inches while the span of the lower is 20 feet 6 inches, giving an area of 125 sq. ft. A Clark "Y" section is employed. The empty weight is 459 pounds.

This is Elmer Smith's neat little biplane that has been flying so successfully around Eugene, Ore. This ship was shown in flight in a previous issue of P. A.

More Dope on P. A.'s Model Contest

Here's he's winding up the Boeing "247" with an electric starter. Model builders should carefully note the details shown by this view.

TO JUDGE from our correspondence, the Second POPULAR AVIATION International Airplane model contest has taken the model world by storm. Nowhere else can you compete for such valuable prizes as those being offered in this biggest of model events.

All this has been made possible by the collaboration of United Air Lines and the Boeing Airplane Company with the staff of POPULAR AVIATION. Long air line trips on the palatial monoplanes of United Air Lines are open to the winners of the first three places, while the other contestants will receive commensurate awards. There'll be twenty prizes in all—all of them worthy of your best efforts in building a model.

A full description of the prizes, the method of entering the contest and the rules governing the contest were given in full in the October issue of POPULAR AVIATION, but for the benefit of readers who did not receive this issue we will repeat some of the leading points, and will endeavor to straighten out certain rules not made clear in the first announcement.

First, last and always, remember that this contest is open to all of our readers living in the United States, Canada and Mexico. It would have been opened to our friends in Europe, Asia and Africa as well, but the nature of this year's prizes prevents us from so doing. Outside of this single restriction it is wide open to everyone. You don't even have to be a subscriber nor we don't care how old you are.

Contrary to the rules of last year's contest, only one type of model is to be built. This is to be a model of the Boeing low-wing Wasp-powered transport plane that has recently been placed in service on United Air Lines. It is known as the Boeing "247." Models of other planes will not be admitted to the contest. Limiting the construction to only one model greatly simplifies matters for everyone concerned and most of all—to the builder who will be provided with plenty of information in the various issues of P. A.

You are to build this model as accurately to scale as possible so that it

How to Enter the Contest

1. *Build a model of the Boeing "247." No other model will do.*
2. *When completed take several photographs of your model so that we can see several sides of it. Good clear snap-shots will do.*
3. *Paste the accompanying coupon, or an accurate facsimile of this coupon, on the back of each photo for identification, filling out the required data.*
4. *Send the photos to* POPULAR AVIATION, *Model Contest, 608 S. Dearborn St., Chicago, Ill.*
5. *DO NOT SEND THE MODEL UNTIL WE ASK FOR IT.*
6. *Start your model early so that you will not be rushed at the end of the time. Carelessness may spoil your chances of winning a prize.*
7. *December 15, 1933, is the last day on which photographs may be mailed.*

Your name and address must be on the back of every photograph submitted in this contest. This coupon, or a facsimile of it, should be pasted on the back of each photograph.

POPULAR AVIATION SECOND INTERNATIONAL MODEL AIRPLANE CONTEST
608 South Dearborn St., Chicago, Ill.

Please enter this photograph of my competing model in your contest. My entry is an accurate model of the Boeing "247."

☐ Flying model. ☐ Non-Flying model.

Name .....

Address .....

City..... State.....

A large scale drawing of the Boeing "247" suitable for tracing (scale $\frac{3}{16}$" to the foot thus reducing the model span to 23 inches approximately). Simply fill out the coupon below and mail it to the address given.

POPULAR AVIATION, Box 210, 5-33
608 S. Dearborn St.,
Chicago, Ill.

Please send me the large scale plans of the Boeing "247" monoplane.

Name .....

Address .....

City..... State.....

will be a perfect reproduction of the large plane. It can be of any desired size, either a flying or non-flying scale model, and you can build it from the raw materials or from a kit. As in former contests, the model will be judged by the workmanship, accuracy as to detail and the excellence of the finish. Insofar as possible, it is to be an exact reproduction of the large plane in matter of detail.

The general layout drawings for the model and a description of the ship were given in the Model Department, October issue. Several photographs were also shown in that issue and in addition to the photos in this number and numbers to come, the contestant will be shown the various distinctive details of the Boeing "247" plane. The outlines of this plane are comparatively simple and in no way is this ship so difficult to build as the various military planes with their multitudes of small details.

After the model is completed, you are to send in several clear distinct photographs of it—snap-shots will do—and we will judge which models are eligible for further direct examination.

But—do not send us the model until we ask for it. Wait until you get a letter from us asking for the model. However, send in the photographs as soon as possible, each photograph with one of the coupons pasted on the back or a facsimile of the coupon carefully printed on the back of the photo.

This contest closes December 15, 1933, and no photographs will be accepted that bear a postmark later than this date. It will help both you and ourselves if the photographs are sent considerably in advance of this date—the sooner the better.

And now to answering some of the questions that have been received from readers who have written in concerning the various regulations and rules of the contest.

20 Prizes Offered

1st. Prize. A 6,000 mile trip on United Air Lines in one of the new Boeing "247" low-wing twin-motored monoplanes and a two-day vacation with all expenses paid. Choice of Seattle, Oakland—San Francisco, or New York City and return.

2nd. Prize. A 3,000 mile trip on United Air Lines in one of the Boeing "247" monoplanes and a two-day vacation with all expenses paid.

3rd. Prize. A 2,000 mile trip on United Air Lines in one of the Boeing "247" monoplanes and a one-day vacation with all expenses paid.

4th-5th-6th-7th Prizes. Beautiful 20 inch silver scale trophy model of the Boeing "247" monoplane mounted on a pedestal.

8th-9th-10th Prizes. Authorized inspection tour of the nearest United Air Lines port. Here, the pilot in charge will explain all of the inner workings of the Boeing "247" monoplane.

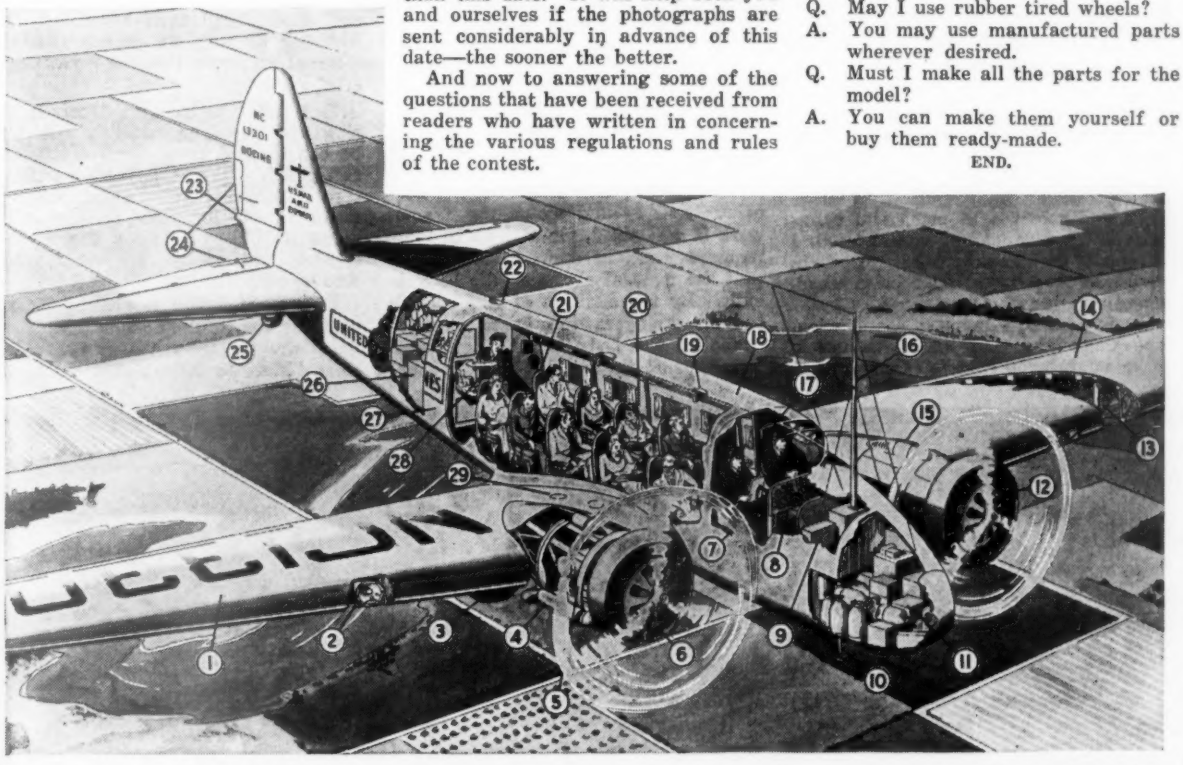
11th to 20th Prizes. A three-year subscription to POPULAR AVIATION.

SPECIAL NOTICE

All prize winners will be given a gold medal of honor as a permanent testimonial of their ability as model builders.

Q. How does the landing gear retract?
A. The two front struts are hinged and the wheels move backward into the wing.
Q. Has the motor an exhaust ring and pipe?
A. Both motors have exhaust rings and pipes.
Q. Where does the radio antenna attach?
A. On an upright steel pole in front of the Pilot's cockpit and back to the fin.
Q. Is the rear wheel shock-absorbing?
A. The rear wheel has a shock-absorber similar to that of the front wheels.
Q. On what side of the body is door?
A. The door is on the right side of the plane.
Q. In what direction does the door open?
A. The door handle is toward the rear and the hinges are toward the front.
Q. How are controls made movable?
A. With small hinges or soft flexible wire for the model.
Q. How many seats are there for the passengers?
A. Ten.
Q. What kind of covering would you recommend for the model?
A. Use your own judgment; tissue paper, light cardboard, light balsa, or light aluminum.
Q. May I use rubber tired wheels?
A. You may use manufactured parts wherever desired.
Q. Must I make all the parts for the model?
A. You can make them yourself or buy them ready-made.

END.



A phantom view of the Boeing "247" showing the essential parts of the plane: (1) All-metal, 74 foot wing; (2) Landing lights; (3) Landing wheel in retracted position; (4) Exhaust stack from engine; (5) Engine nacelle containing oil tank and engine accessories; (6) 550 h.p. supercharged Wasp engine; (7) Dual controls; (8) Instrument panel; (9) Radiophone for two-way communication with ground stations; (10) Air-speed indicator tube; (11) Mail-Express-Baggage compartment; (12) Shutter for controlling engine air-cooling; (13) Thick wing construction; (14) Dural wing, strong as steel; (15) Oil radiator; (16) Radiophone antenna; (17) Pilot and mate; (18) All-metal fuselage insulated against noise and heat; (19) Ventilators; (20) Individual ventilators and heaters at each chair; (21) 10 passengers accomodated; (22) Lavatory; (23) Tail-light; (24) Patented flaps for trimming plane in flight; (25) Tail wheels; (26) Mail-Express-Baggage compartment; (27) Pantry; (28) Stewardess; (29) Gasoline tanks housed within wing.

Building the P.A.Contest Model

by JOSEPH S. OTT

PART II

In this article, Mr. Ott continues the series of instructional articles and helpful hints on the model to be built for the contest. Read the rules and regulations for entering the contest on page 322.

IN ORDER to give the model builder a clearer idea of the various model constructions which may be entered in the contest, the following brief description of a solid wood scale model and a built-up scale model are given.

The photographs below illustrate clearly the complete construction and should assist the builder in definitely making up his mind as to what kind of model he prefers and which one he thinks would have the best chance of winning a prize.

The solid wood scale model is by far the simplest to build and it should not be imagined, because of the simple parts required to complete a model of this type, that it will not have an equal chance to place among the prize winners. Plenty of detail can be worked into this type of model.

The cockpit and passenger compartment can be hollowed out and such details as windows, instrument boards, seats, and doors are easily added. The landing gear can be made retractable by hinging and cutting out a small section in which the wheel and landing gear can recede. The controls on the wings may be put in as separate units and hinged on flexible wire.

The motor nacelles can be finished with such detail as a motor ring made up individually, small exhaust pipes which can be bent from thin brass wire and soldered in place and cylinders finished which are spaced around a small crankcase. The propellers could be constructed from balsa wood, aluminum, brass or hard wood.

It is advisable in most cases, when the units are very small, to use a type of material that is stronger than balsa wood and one which will take on a nice smooth finish. Bear in mind at all times that the external finish of a model is of utmost importance and should not be neglected in the least.

The radio antenna is an additional small detail which should not be forgotten. The windows should be fitted with a nice clear grade of celluloid. The stabilizer and rudder should be sanded to a perfect streamline shape and the elevators and the rudder should be hinged and movable. The size of the model will govern the details to a great extent. If the model is large enough, so that the pilot's seats and controls can be added, then they should not be omitted.

Balsa wood will take a very smooth finish if dope is applied at first and sanded after each application. About 5 applications of dope prepare the balsa so that the final finish may be applied. It will be necessary to allow each coat to become thoroughly dry before another is applied and only then should it be sanded.

The second type of model is of the flying type or built-up kind. It is not necessary that the model fly to be classified under this type. The body may be constructed with longerons of any number found necessary to lay the foundation of the general framework. Assuming that four longerons are necessary and around which the framework is assembled, place these in their required positions and add formers so that the general shape of the body is built. By the addition of small longitudinal stringers the exact external shape of the body can be developed. This type of construction requires more work and carefulness and will surpass a solid wood type of construction provided the workmanship is of a high-grade.

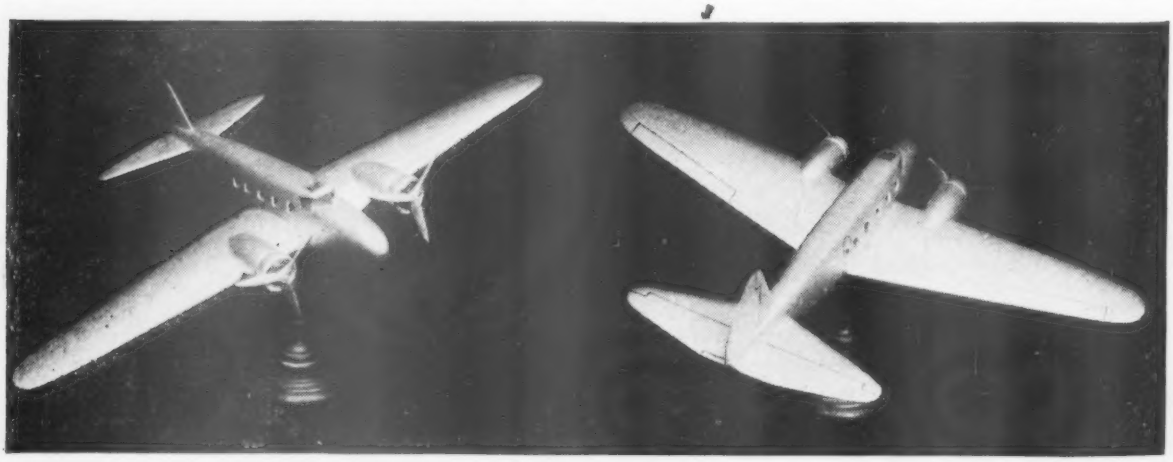
The covering may be of any suitable material—tissue paper silk—balsa wood which should be applied in small sections and may even be of aluminum also applied in small sections. It will be found that thin aluminum can be readily applied with airplane cement.

The construction of the windows, the pilot's cockpit, and the door are details which should be considered before applying the covering to the fuselage.

The wing would be constructed of various size ribs and the general method of using spars, entering edge and trailing edge should be employed. It will be readily understood that the more ribs used in the wing, the neater will be the finished part after the covering has been applied. It may be advisable to make the wing very strong so that the covering may be doped and doping will tend to shrink this covering to such an extent that the internal structure in some cases might crush.

The motor units which include the ring and the long nacelles may also be constructed from small pieces and assembled. On the flying or built-up type of model it would be advisable to make all of the units on the entire plane of built-up pieces thereby retaining uniformity of construction throughout.

But, to sum the whole matter up, neatness, careful workmanship and finish are the three things that count most. More to follow, next month.



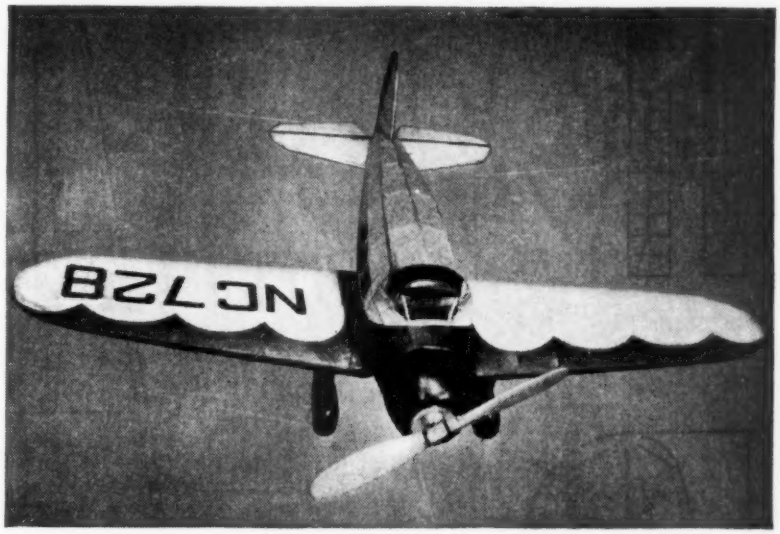
Two views of a Boeing "247" model mounted on a pedestal. This is a solid wood model, very carefully finished, but it is not necessary for the entrants to provide the pedestal.

Building the Gee-Bee Transport

by

JOSEPH S. OTT

Model Editor of POPULAR AVIATION



The completed Gee-Bee transport model adapted after the ship featured on the September, 1933, cover of P. A.

AND NOW the Gee Bee Transport — and what a beauty! It has all the clean lines of a high speed ship and proportions from nose to tail that are perfect.

The motor cowl may seem small but this proves that a transport need not be all motor to obtain a speed of around 225 m. p. h. The pilot sits high and to the front of the leading edge giving him plenty of visibility.

Low wing models are never quite as stable as high wing or biplane types and for this reason it is advisable to concentrate the heavy part of the model below the wing level if possible. In this model it may be accomplished by making the landing gear struts, the pants and the wheels out of solid balsa. It is also advisable to use heavier wood for the lower longerons and the lower body formers (including the stringers) and to use the lightest wood obtainable for any part which would come above the wing level.

In this way, the maximum bulk of weight will be concentrated so that the model will have a very low center of gravity. The balance of a model in relation to the center of gravity may be compared with a pendulum where all the weght is carried at the extreme end.

Do not worry about getting too much weight below the wing level in a model of this type because the body and the greatest part of the structure is above the wing.

Note from the photographs that the wing and the body are built in two entirely separate units. The landing gear is attached to the main spar and an auxilliary spar which reaches up to rib No. 2. To be true to scale the propeller would be approximately 4 inches in diameter, entirely too small for the model. The dimensions given in the drawing call for a propeller 6 inches in diameter.

A model of this type will naturally have a high speed as far as scale models are concerned and before any attempt is made to fly it is advisable to check the balance very carefully, adding a little weight in the nose or tail as required and testing the model in deep grass if possible. The grass may puncture holes in the tissue occasionally but the breaking of any part of the structure is prevented by the cushion effect of high grass.

All the drawings in the model Department shown lately have been illustrated to scale equalling 10 inches for the maximum wing span. This is usually a scale equalling ½ of the 20 inches specified for the model.

However, when laying out the fuselage, wing or other parts it is simple enough to increase the scale so that it may be 2, 3, or even 4 times the scale illustrated in the magazine.

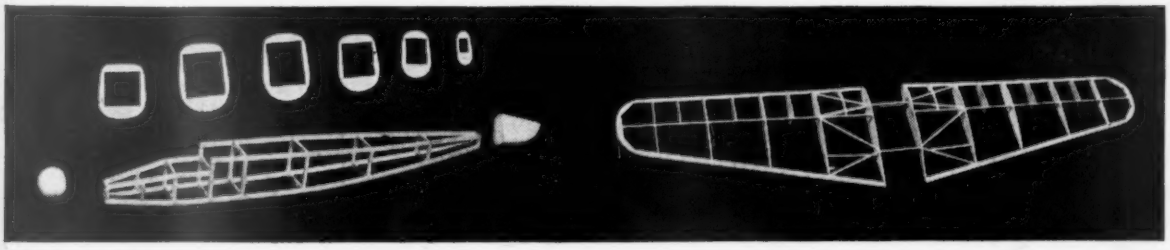
For a 30 inch model, the longerons should be approximately 3/32 inch square. For the 36 inch model, ⅛ inch square and for a very large model or one having a wing spread of 40 inches, the size material used for the

(*Continued on page* 328)

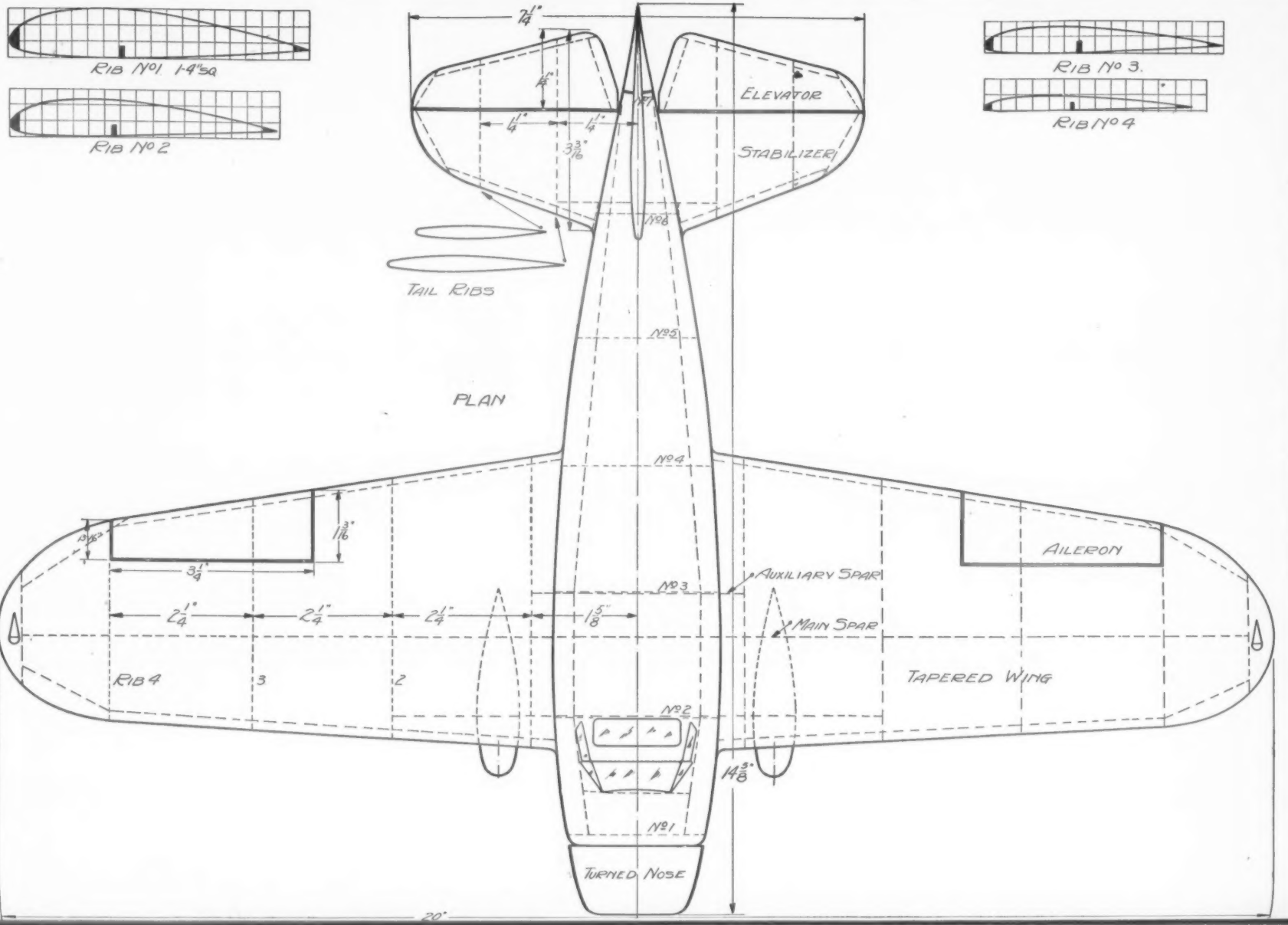
Fuselage with formers added.

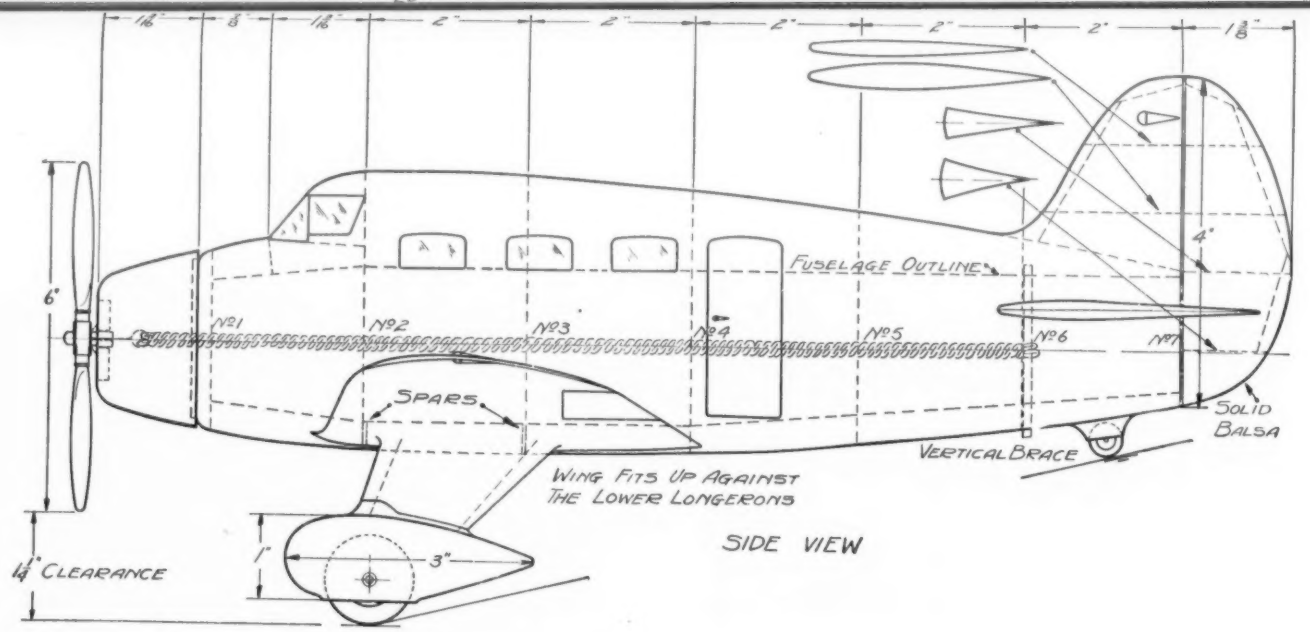
Fairing is now laid on.

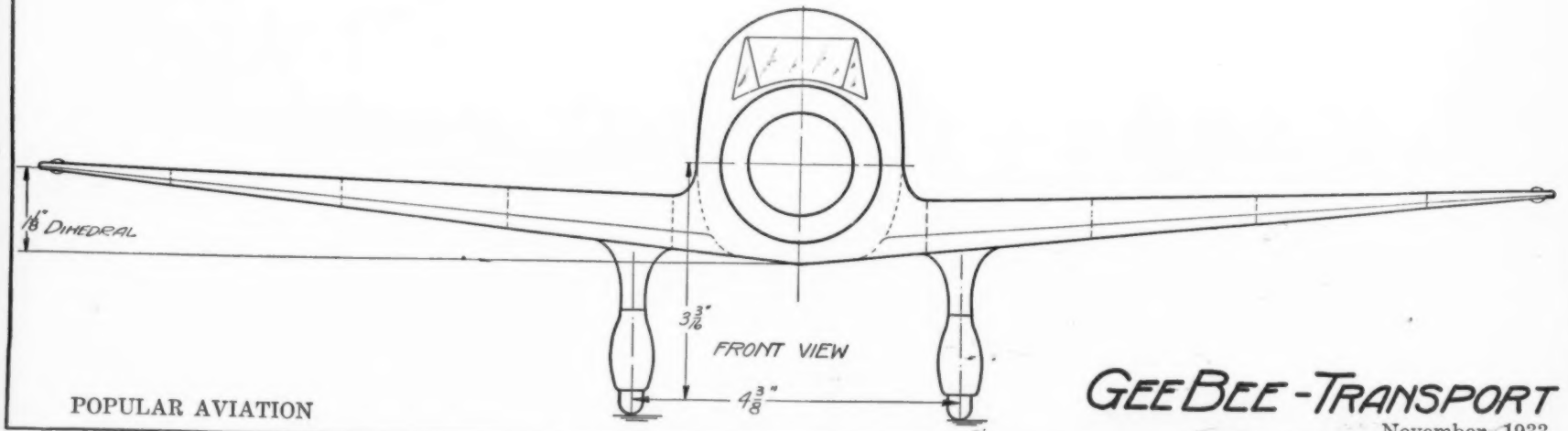
The wing and chassis unit.



At the left, the fuselage longerons are assembled with the formers shown above. At the right is the c mpleted wing ready for attaching the landing gear.


RIB No1 1-4"sq
RIB No 2
RIB No 3.
RIB No 4
2 1/4"
ELEVATOR
STABILIZER
1/4"
1/4"
3 3/16"
No 6
TAIL RIBS
No 5
PLAN
No 4
1 3/16"
3 1/4"
AILERON
No 3
AUXILIARY SPAR
2 1/4"
2 1/4"
2 1/4"
1 5/8"
MAIN SPAR
RIB 4
3
2
TAPERED WING
No 2
14 5/8"
No 1
TURNED NOSE
20"
1/16"
1/8"
1/16"
2"
2"
2"
2"
2"
1 1/8"





GEE BEE - TRANSPORT

Model

(*Continued from page* 325)

fuselage longerons should be approximately 5/32 inch square. All other parts for the spars, leading edge, ribs, etc., should have a slight proportionate increase in dimensions.

Prepare two body sides by cementing the uprights to the longerons in their specified positions. When increasing the side of the model, it is advisable to have the spacing between the uprights not over 3 inches therefore in a larger model it is necessary to add additional uprights and cross-braces. After the two sides have been assembled, they should be joined together by the top and bottom vertical cross-members, making the first part of the body complete.

Cut out formers and add these in their required positions for the entire length of the fuselage. At this time the cockpit should be assembled and an extra small former is required just in front of the lower end of the cockpit. The top part directly above the pilot's head is carved from a small piece of solid balsa and should be hollowed out underneath and a window cut in through the top. Cement this top piece against former No. 2 and finish the construction of the cockpit.

The next step is to add the stringers which are placed on top of the formers. Three are used on each side and one on each corner, making a total of 16 stringers for the entire body. One of the photographs illustrates the space left between formers No. 2 and No. 3. This space extends into the body up to the longerons. The auxiliary spars in the wing should be deep enough to rest up against the longerons. At the 6th body station a small brace is placed between the lower and the upper longerons which hold a small 1/8th x 3/16 inch vertical upright in position to which the rubber motor is attached.

The small tail wheel at the rear is held in place in a very small pant, which is attached between two stringers near the rudder post. Cement a small piece of balsa between the stringers before attaching the tail wheel pant.

The ribs for this model are tarered both in depth and in length, and additional care should be used in laying out the full size ribs for the model under construction. After the 4 main ribs have been cut to the proper shape and assembled to the single spar, the leading and trailing edges are attached, then the wing tips, and when these parts have all dried, the auxiliary spars are cemented at the center. The nose ribs are added after the wing has been assembled. The height and depth of these are just a little less than the rib nearest the body.

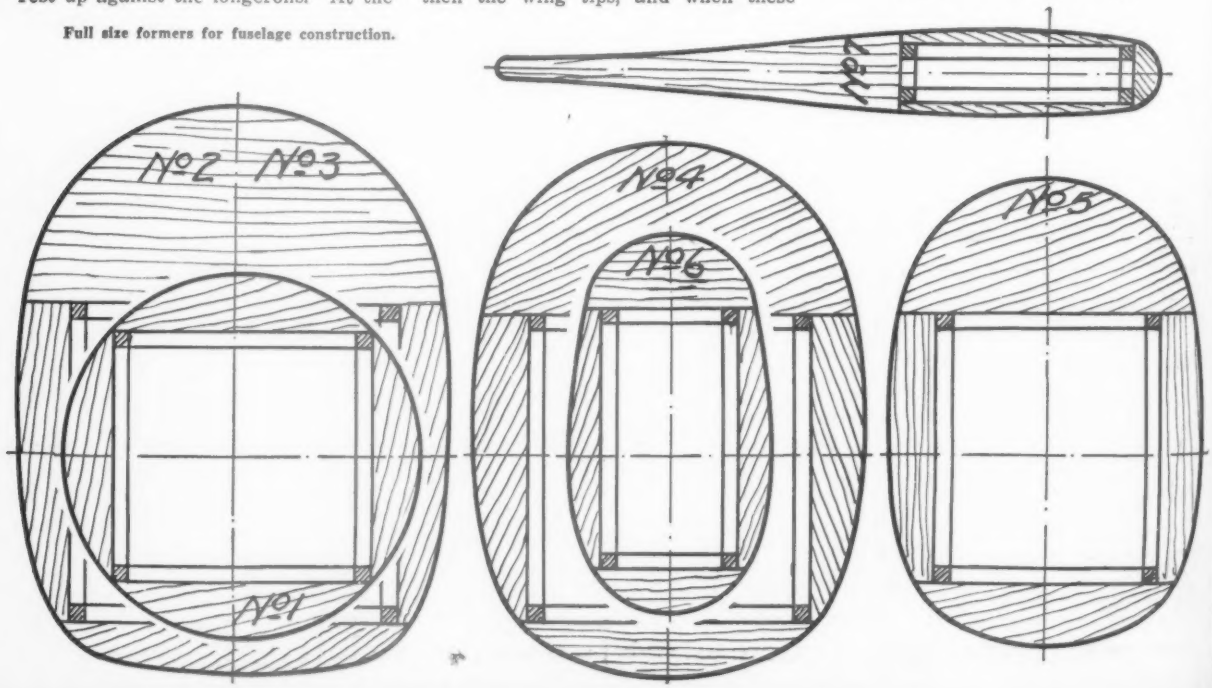
You will note the structure of the wing which rests next to the body. This part is built by adding two small formers in a vertical position and adding a small former to conform to the shape of the body and at the same time streamlining the wing against the body.

The wheel pants are constructed entirely from balsa and the center section should conform to the specified width and length allowing sufficient space at the front center to accomodate the 1 inch wheel. The out-

(*Concluded on page* 335)

List of Materials

Longerons	1/16 x 1/16 x 18"	Balsa	8
Propeller	6 inch diameter	Balsa	1
Spars	1/8 x 1/8 x 18"	Balsa	1
Entering Edge	1/4 x 1/4 x 18"	Balsa	2
Trailing Edge	3/32 x 3/16 x 18"	Balsa	2
Fairing Strips	1/32 x 1/16 x 18"	Balsa	12
Struts—L. G.	1 x 1 1/4 x 2 3/8"	Balsa	2
Ribs, etc.	3/64 x 2 1/2 x 18"	Balsa	2
Motor Cowl	1 3/8" L. x 2 1/8" Dia.	Balsa	1
Shaft	.024" diameter	Wire	1
Washers	1/8" diameter	Brass	3
Bearing	Turned	Wood	1
Wheels	1" diameter	Wood	2
Wheel	1/2" diameter	Wood	1
Pants (Inside)	3/8 x 1 x 3"	Balsa	2
Pants (Outside)	1/16 x 1 x 3"	Balsa	4
Rubber	1/32 x 1/8 x 60"	Para	1
Cement	Clear	Tube	1
Banana Liquid	Clear	Bottle	1
Tissue	Red — 20 1/2 x 24 1/2	Hakone	1
Tissue	White — 20 1/2 x 24 1/2	Hakone	1



Full size formers for fuselage construction.

What the Industry is Doing

Latest bulletins from the airplane, engine, equipment manufacturers and dealers boiled down into a nutshell. Contributions to this department are invited.

WHEN LADY HAY-DRUMMOND-HAY came to America recently, to select a new plane, she set her stamp of approval upon the Continental 7-cylinder, 210-horsepower radial engine with which her Waco plane was equipped. Her ladyship regards American-built planes and engines superior to those of other manufacturers.

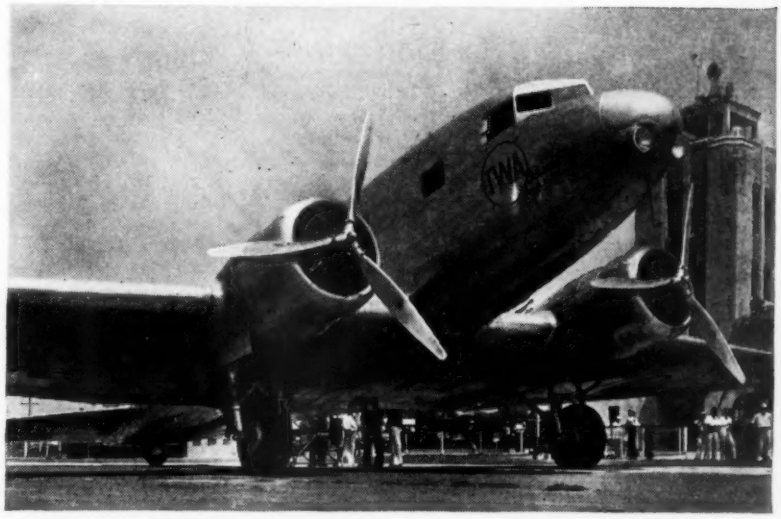
THE FIRST OF THE FLEET of the Boeing all-metal low-wing P-26A pursuit planes for the U. S. Army Air Corps has been test flown. Bodies of the diminutive Wasp-Powered fighters are coming off the assembly jigs in rapid succession, indicating that a considerable number of these planes will be out of the Boeing factory by the end of the year. The P-26-A is an externally braced single seat fighter, generally similar to the XP-936.

T. W. A. GETS DOUGLAS AIRLINER, a twin-motored low-wing monoplane having great speed. It is a 12-passenger ship, all-metal construction, which is provided with two 700-horsepower super-charged engines. All proven safety factors will be incorporated in this new ship.

ACCORDING to the Department of Commerce, Aeronautics Branch, the average cost of an air line trip in continental United States is 6.1 cents per mile. In 1926, the average fare was 12 cents per mile. And it should be noted, that on long air journeys, the price of a passenger ticket includes meals served while in flight.

A NEW FAIRCHILD is being developed along the lines of the Fairchild 22, the difference lying in a more complete stream-lining for the attainment of higher speeds. Provided with a Warner engine it is expected to have a top speed between 135 and 150 miles per hour.

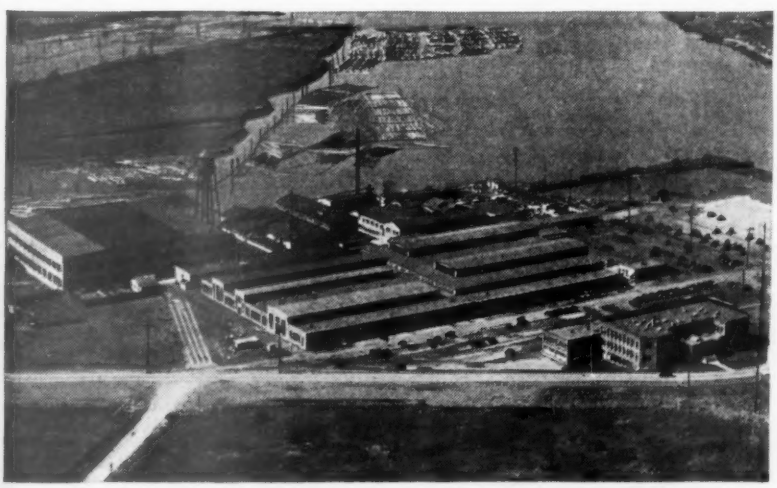
THE TULSA MUNICIPAL AIRPORT has shown a net operating profit of $5,967 (without depreciation) for the fiscal year of 1932-1933. In these times this is a mighty good showing.



Front elevation of the monster Douglas Twin-motored transport plane recently delivered to the Transcontinental and Western Air. It has a total power-plant output of 1,400 h.p. and is said to have a remarkable performance although the figures have not yet been made public.

WRIGHT ENGINES, according to the Wright Aeronautical Corporation, Paterson, N. J., are now operating in 43 different countries throughout the world. This includes both commercial and military service.

HAVING COMPLETED its order of 60 Boeing "247" transport planes for United Air Lines, the Boeing Airplane Company, Seattle, Wash., is progressing steadily on 15 additional planes of the same type for the general market. The last of the planes on the United Air Lines order left the factory less than five months from the time that the first of the fleet was delivered.



An airplane view of the Boeing Airplane Company's plant at Seattle, Wash., where many planes are now under construction, including fifteen new Boeing 247's.

COMMANDER RICHARD BYRD has received his Curtiss Condor biplane with which he is to make further explorations in the Antarctic regions. The original monoplane employed on the first expedition, is now buried in the antarctic snows, but if possible will be put into service as an auxiliary to the Condor.

AIRLINES FLEW MORE MILES in July, 1933, than in any other month of scheduled air transportation in the United States, according to reports from the Department of Commerce, Aeronautics Branch. During this month, they flew a total of 4,868,717 miles over the airways of 27 operating companies. The total passenger miles were 21,417,110 which shows that the average number of passengers per mile was slightly over two.

AN AIR SERVICE STATION has been established by the Gulf Refining Company under the direction of Capt. Al Williams near Hicksville, L. I., N. Y. All they have to do now is to pull up to the pump and answer the question: "How many?"

TWO CONDORS have been purchased by the U. S. Army Air Corps for use of executives. They are the same as the Condors in use on the airlines except for the seating arrangements.

THE BOEING 247-A, equipped with two twin-row Wasp engines of 650-horsepower have been designed for the use of the executives of the United Aircraft & Transport Corporation. These are essentially the same as the 247 model except for an increase of 100 horsepower and the substitution of eight cabin chairs instead of ten.

A NEW TWIN-ENGINED MONOPLANE, known as the type P2-Y2, has been tested by the U. S. Navy Department. This ship, built

by the Consolidated Aircraft Corp., Buffalo, N. Y., is provided with bomb racks and machine guns. It is built to carry a pilot, navigator and two passengers, or equivalent.

DURING THE FIRST 6 MONTHS OF 1933, 669 airplanes were manufactured in the United States of which 306 were for civilian service. This included 215 monoplanes, 84 biplanes and 7 Autogiros. This report, by the Department of Commerce, Aeronautics Branch, does not include the many amateur planes built during this period.

AERONCA PLANES and engines are discussed in an interesting manner in the Booklet, "The Aeronca" issued by the Aeronautical Corp., of America. Besides the discussion on the Aeronca there is also much interesting dope on how to organize flying clubs, how to make money by flying and other material of interest to the private and professional pilot.

THE SPARTAN SCHOOL OF AERONAUTICS reports a marked increase in its student enrolment.

AN IMPROVED DE-ICER with a new weight minimum has been perfected by United Air Lines engineers in collaboration with the Goodyear Rubber Company. This device was tested under icing conditions at an elevation of 19,000 feet. A reduction in weight from 150 pounds to 45 pounds was accomplished by substituting balloon silk for rubber edges cemented to the top and bottom surfaces of the wings and stabilizers. Air, at 10 pounds pressure is then pumped through these silk tubes.

AIRPORT LIGHTING CABLE for underground service is described in the booklet, "Armortite Cable," issued by the Westinghouse Electric and Manufacturing Company. A very good idea of underground construction for airports can be had from this booklet.

IN THE FIRST SIX MONTHS OF 1933, the Waco Aircraft Company, Troy, Ohio, has forged ahead very rapidly in the number of sales made both in the United States and abroad. They have been highly successful in the export field.

THE CHINESE GOVERNMENT has decided that the national defense of China rests in the airplane. Therefore, it is estimated that the government will purchase more than 3,000 military planes during the next three years.

END.

Knight-Twister

(*Continued from page* 320)

chalked centerline on the fuselage we must put them there.

A good way is to stretch two lines of cord, one about two inches above the floor and exactly above the chalked centerline on the floor. The second line is above the jig and also exactly parallel and above the chalked centerline on the floor.

Now, standing either at the front or tail of the jig, you can sight along these two lines and see if the chalked center marks on the cross-tubes are in line with these two cords. If not, push it over at the top of the jig or where it is out of place, hold it there with a shim of steel, or so it will stay till a diagonal is welded in place. When all diagonals and internal bracing are tack welded, the fuselage should still be square and in line with these two cords.

Remember, be careful in fitting these tubes. After all this trouble you do not want it to distort out of shape when you start finishing up the welding at the joints. This is done after removing the fuselage from the jig.

With the fuselage in an upright position on a couple of saw horses, and the joints all welded, you are ready to put in the tail-post. In handling, you may have brushed off the chalk marks on the centers of the cross-tubes and if so, remark them. Tie a string or cord to the center of the cross-tube, in the top truss at station No. 1, run the string forward and tie to the center of the cross-tube at station No. 7.

This string should lay on the centers of all the cross-tubes in the top truss if the fuselage did not distort. A second string is stretched through the fuselage from the center of the cross-tube at station No. 2 to the center of the cross-tube at station No. 7 in the lower truss.

Placing the tail-post is a delicate operation, you will cut and fit many times before welding. The tail-post should be held in place with wire so that you can go to the front and sight along the strings to see if in line with the tail-post. In sighting along these strings you should see the tail-post not on one side or to the other side, but smack in the middle of both top and bottom trusses.

Now lay a straight edge across the fuselage at the forward end, and have some one hold a 2 foot square alongside the tail-post, with the square sticking out to one side, at the top longeron. If you stand back, you will be able to sight over the square and the straight edge to see if the tail-post is square with the top longerons. It will then be square with the fuselage.

The fin (vertical) may now be welded onto the tail-post. The small tubing and fittings for the wings may also be put on now. The wing fittings are placed so that the wings are inclined at 3° to the top longerons. This means 3° angle of incidence when the ship is flying with the top longerons level.

The fuselage drawing showing the top and bottom trusses, has also drawings of cross-sections of the fuselage at stations No. 5, No. 6 and No. 7. This shows the size of tubing.

Stations No. 5 and No. 6 are made so that the pilot's legs can go through without too much crowding. Station No. 7 has the front of the landing gear and the landing gear shock struts fastened to it. The shock struts come inside of the fuselage and connect to the center of the cross-brace at the top truss.

The top wing fittings are built like the bottom wing fittings. All are of 16 gauge cold rolled sheet steel. The fittings look like channel irons, that is, the sides are bent up to reinforce them. All bolts in the wing fittings that pass through the spruce spars of the wings, are ¼" diameter, nickel steel with castellated nuts.

The landing gear fittings on the fuselage at stations No. 6 and No. 7 will be shown in the chassis drawing. The stabilizer fittings on the fuselage are to be shown in the tail surface control drawings. The tail skid is a 4 leaf spring, each leaf ⅛" thick and 1" wide, with a cast steel shoe bolted to the end.

END.

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Airy Chat

(*Continued from page 286*)

very well commissioner, it might be well to find out what the tax-paying pilots think about it.

* * *

THE third proof that the Airy Chat is read, comes from about forty-eleven notebook fans who think that it would be a fine idea for the bunch to submit pages from their notebooks for publication in P. A. And so, being agreeable to all such suggestions, we will ask you to submit useful and interesting notes from your files on various subjects applying to aviation. These can be rules, formulae, recipes, methods of calculating, shop-kinks, airplane data—anything you wish. But please don't send your original notebooks, send only a copy of the page. We'd hate to be responsible for such valuable collections.

* * *

PROOF No. 4, that the Airy Chat has regular customers, is a deluge of epistles requesting more full page photos of airplanes. You see, these fans cut out the full page pictures and paste them up in their dens, ice-wagons, hangars—and everywhere else. They will soon be displacing the photos of the film actresses that have so prominently roosted hitherto, in dens, ice-wagons, hangars—and everywhere else. Greta Garbo comes down and a photo of plane XP-1227-A-2M-c takes her place.

O.K., fellows, your wish will be granted. Look for the big picture in an early issue—it'll be there.

NEW BROADFIELD ZOOM SOARING GLIDER

Built to Fly 75c P P. 15c

Oh Boy!—What a Soarer—What Performance—Throw it against the wind and watch it zoom high in the air and soar smoothly away. Strongly constructed like a contest glider—selected balsa, cambered wing—all surfaces smoothly sanded, N.R.A. insignias on wings. Satisfaction guaranteed. Built ready for flight or in Kit form. Ask your dealer or order direct from factory.

"ZOOM" SOARING GLIDER KIT 25c Postage 10c

Here is a Quality Glider Kit that builds the glider pictured above. Picture below shows cut to shape parts ready for quick and easy assembly. Only finest grade "A" balsa used. Complete Kit 25c at dealers or order direct (Postage 10c extra).

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Yale Street, Hempstead, N. Y.

THEN, we've had a flock of letters concerning the "mystery ship" on page 139, September issue. About 97 per cent hit it right. It is a Standard J-1 as we afterwards discovered. This old crate has quite a history which we will probably retail to our readers some of these days.

* * *

TO ALL those who have written in concerning levitation — greetings. These replies have been a most interesting psychological study, better and more varied than we had hoped for. At first, it was believed that this subject could be handled through the Airy Chat, but the replies have been so voluminous that we intend to make a feature story out of these letters—a sort of symposium on levitation, as it were. Some of the criticisms and analyses were quite correct, and some of them were way off the track. Some of the naughty little boys should go back and take MECHANICS I all over again next semester. Most of them also proved that they had not read the article in its entirety.

There were those who believed that we have to push on the earth or the air, those who did not understand that centrifugal or centripetal force is the result of an acceleration, those that—oh, why start it here. Wait for the big symposium of levity!

* * *

DID you ever read that interesting book, "Life Begins at Forty?" Well, to make a long story short, the author states that youth is conservative in its opinions and that the oldsters are really the radicals! This was proved to be correct without a doubt in this levitation matter.

It was the band extending from 16 to 25 years that defended present conventional aviation methods from invasion, while the zone ranging from 25 to 60 years were the most enthusiastic on a new and radically different system. High-school boys and college students battled against the project of levitation. Several experienced research engineers, though not in accord with the methods indicated, were quite enthusiastic over the idea in its general aspects.

* * *

ROBERT F. Rose, R. F. D. Box 30, Novato, Calif., writes in and tells us that he believes that a series of articles on "How to Become a Licensed Pilot" would be just about the thing. But the lines that warm our old heart with pride are those in the postscript which read:

P. S. I believe that POPULAR AVIATION *is the best magazine published in the United States—bar none—and I have read everything printed from Ballyhoo to the Sunday School Journal.*

Here's something else for you to ponder over. Do you think that such a series would go over?

* * *

BENJAMIN FRANKLIN, one of my favorite heroes, was a most versatile and ingenious man. He became intensely interested in ballooning after he witnessed the Montgolfier Brothers' first ascension at Paris in 1783. Further, he had the gift of gracefully avoiding prophecies in science, which in the language of today, might be called "stalling."

After the Montgolfier had ascended, one of his party asked Franklin the question, "Of what use is it?" Then the crafty Franklin answered with another question, after careful consideration, "Of what use is a new born babe?"

I offer this as a model stall for certain of our own time scientists and engineers who are so careful about committing themselves and risking their personal dignity that they fear to give an intelligent prediction on developments that their own experience should make certain.

* * *

AFTER months of fluctuating hope and doubt, it rather seems that the L.A.A. has a chance of materializing in physical form after all. Members keep coming in at an increasing pace so that the prospects are very bright for the fulfillment of the amateur's dream.

* * *

COMMANDER Richard Byrd is to make another attack on the South pole via airplane. It is quite interesting to note that he has adopted a biplane as his flagship on this trip in spite of the propaganda running to the effect that a biplane is an ice accumulator.

* * *

ACCORDING to the dope, only 24 licenses have been issued for operating Autogiros in the United States. What's the matter with the flying wind-mills?

* * *

WELL, here we are at the end of our space, but before signing off, I would like to call your attention once more to two important things. (1) *Print your name and address for the Barter and Exchange,* (2) *Watch for the full page photo. So long.*

J. B. R.

12" Ornamental Models

Photograph of the Hawk P-6-E Model

A T L-A-S T". A striking, true scale reproduction of the famous CURTISS HAWK P-6-E and GEE BEE SUPER SPORTSTER at a price that you can afford. Each an art piece of rare beauty and distinction.

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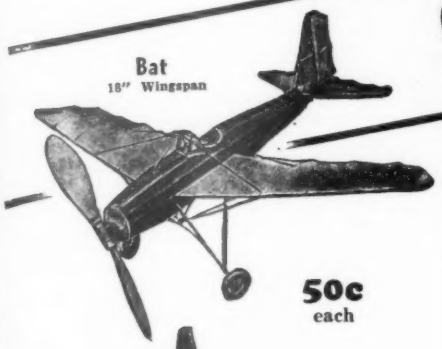

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50c each

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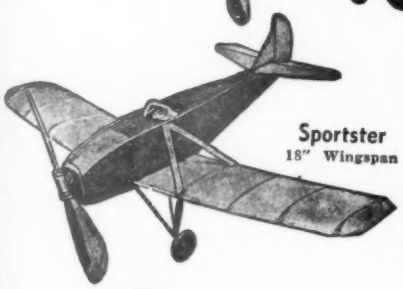
18" Wing



Sportster
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15" Wingspan { Hawk P6-E, Boeing P-12, Vought Corsair, Lockheed Sirius

18" Wingspan { NORTHROP GAMMA, PUSS MOTH

Each Kit is complete with special turned parts, printed Balsa sheet, balsa spray, Colored Jap paper, rubber cement, Insignia and everything necessary to construct any one of these models.

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Hawk P6-E
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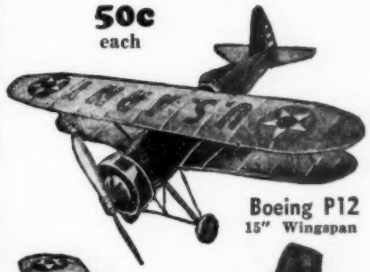

Boeing P12
15" Wingspan

Vought Corsair
15" Wingspan

Lockheed Sirius
15" Wingspan

Captain Mollison's
The Heart's Content
Puss Moth
18" Wingspan

Northrop Gamma
18" Wingspan

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1/32x3/32"	.10 for 5c
1/16x1/16"	.12 for 5c
1/16x3/32"	.12 for 5c
1/16x1/8"	.12 for 5c
1/32x3/32"	.5 for 5c
1/32x1/8"	.5 for 5c
1/8x1/8"	4 or 5 for 5c
1/8 x3/16"	.4 for 5c
1/8 x1/4"	.3 for 5c
3/16x3/16"	.4 for 5c
3/16x1/4"	.3 for 5c
1/4 x1/4"	.3 for 6c

LATA BALSA LOGS

36" lengths

1 x1"	.25c ea.
1 x2"	.45c ea.
1 x3"	.60c ea.
1 x6"	.75c ea.
1½x1½"	.50c ea.
2 x2"	.55c ea.
2 x3"	.75c ea.
2 x4"	1.00 ea.
2 x6"	1.40 ea.
3 x3"	1.05 ea.
3 x6"	2.10 ea.

SHEET BALSA

18" lengths

1/32x2"	.3½
1/16x2"	.4½
1/16x3"	.6
1/16x6"	.12
3/32x2"	.5
8/32x3"	.6½
3/32x6"	.12
1/8 x2"	.5
1/8 x3"	.6½
1/8 x6"	.14
3/16x2"	.6
3/16x3"	.9
3/16x6"	.16
1/4 x2"	.7½
1/4 x3"	.11
1/4 x6"	.18
1/2 x2"	.11
1/2 x3"	.18
1/2 x6"	.20

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Red, Orange, Black, Blue, Green, Tan. 20x24" sheet..3 for 10c

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1/16" Sq. Coated, 12" Long ....5c doz.
1/16x1/4" 15" length ..10c doz.

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210 ft. Skeins

1/32" sq.. ft.	¼c
1/16" sq.. ft.	1c
1/8" flat, ft.	1c
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1 bottle 10c

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1¾"	.30c

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SWIVEL TYPE GUN 20c
PURSUIT TYPE GUN 10c

Anti-aircraft Guns ..25c
Dummy Flood Light..25c
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PROPELLERS

Hawk Spinner Type — 3-Bladed, 2-Bladed
Standard Steel Type — DIE CAST SCALE MODEL, 2-Bladed, 3-Bladed

2 BLADED		3 BLADED		2 BLADED		2 BLADED	
3½"	.25c	4"	.35c	1½"	.10c	1½"	.15c
4"	.30c	4½"	.45c	2"	.15c	2½"	.20c
4½"	.35c	5"	.50c	3½"	.18c	4"	.30c
5"	.35c	5½"	.60c	4"	.25c	4½"	.40c
5½"	.40c	6½"	.70c	4½"	.25c	5"	.45c
6½"	.40c	7"	.80c	5"	.30c	6"	.60c
7"	.55c	8"	.90c	5½"	.35c	7"	.70c
8"	.65c	9"	1.00	6"	.40c	8"	.80c
9"	.75c	10"	1.10	6½"	.45c	9"	.90c
10"	.85c	11"	1.25	6¾"	.50c	10"	1.00

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Kit complete including 2 special finished propellers.
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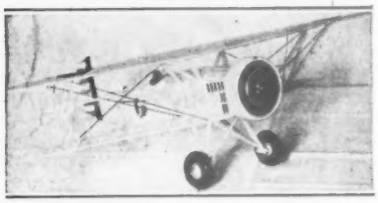
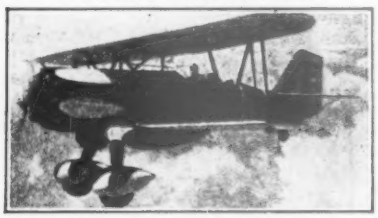
Curtiss Sea Hawk P3A



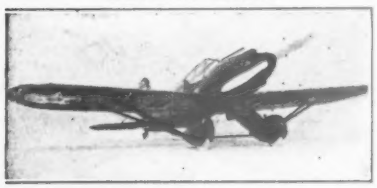
24" Span, Weight 1¾ oz., Flies 900 Feet
Set includes 3" celluloid motor, aluminum motor plate and drag ring, balloon celluloid wheels with silver discs, printed instrument board, fuselage, wing and rudder insignia, aluminum pilot's seat, dope, glue, drawing and all materials. **Const. Set $2.50**

Curtiss Hawk P6E



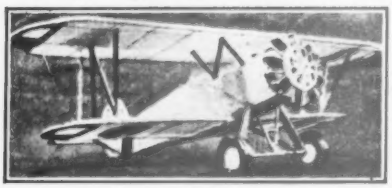
24" Span, Weight 2¼ oz., Flies 800 Feet
The strongest and most perfect model of the P6E on the market, has squadron insignia on pants and fuselage, metal exhaust pipes, aluminum wheels, 2 color dopes, all parts printed on balsa, printed instrument board, semi scale, Fibre prop. **Const. Set Complete, Postpaid.....$2.50**

Curtiss Swift



24" Span, Weight 1 oz., Flies 675 Feet
New Model of World's Fastest Fighter
Set includes semi-finished wheelpants, glistening hollow metal exhaust pipes, strong aluminum wheels, two color dopes, glue, wing and rudder insignia, U. S. Army lettering, detail drawing, ribs, formers, etc., printed on balsa. **Const. Set. Postpaid $1.75**

Boeing F4B1 Pursuit



20¼" Span, Weight 1¾ oz.
Set includes 3" celluloid motor, aluminum motor-plate, celluloid wheels with silver discs, 2 color dopes, fibre prop, ribs and formers printed on balsa.
Const. Set, Postpaid.....$1.95
New 1933 Illustrated Catalogue 10c
Miniature Aircraft Corporation
83 LOW TERRACE NEW BRIGHTON, NEW YORK

Photography

(*Continued from page* 296)

Mr. McKean left for Nantucket Light Saturday morning, where the seaplane was stationed for this epic flight. Instructions for the cameramen in New York, who were to receive Mr. McKean, were as follows. A detail of cameramen to be stationed at Riverside Drive and 96th Street on the New York side of the Hudson River, a similar detachment of cameramen were also directly across the river on the Jersey shore. These cameramen were equipped with guns which fired flares into the air and which could light up that part of the river to enable the landing of the seaplane carrying Mr. McKean and the important films.

The City of New York Police cooperated with Paramount News by the assignment of a motorcycle escort which made it possible to reach Paramount News offices and laboratories on 43rd Street and Eleventh Avenue, through the heavily congested traffic. The time set for the arrival of our Assignment Editor and the film was 9 P. M. Every cameraman, who was instructed to fire the flares, waited anxiously for the signal. The plane would circle this location three times at approximately 9:00 P. M.

Leaving Nantucket Light in the seaplane which was hired for this purpose, Mr. McKean found that the sea was very rough because of the furious northwesterly wind. The day had been very cloudy and a snow storm was threatening the success of this urgent transfer from ship to plane. The difficulty of making a landing on a choppy ocean seemed to be the main disadvantage in the project. However, the plane was fueled and within a few minutes Mr. McKean was comfortably seated next to the pilot, cruising at an altitude of 1500 feet above the sea with their destination 400 miles away.

Everything was going along as they had expected. About 4:00 P. M., they sighted smoke on the horizon which convinced them that the S. S. Leviathan was not far away. The plane performed quite satisfactory, but as they neared the steamship, and circled it about three or four times, they could see the passengers on deck moving excitingly.

The fog horn of this floating hotel could be heard above the din of the engines, and they noticed that the steamship was slowing down to enable them to land and receive the container with the films in it. The engines of the plane were throttled down and the pilot then remarked to me that the sea was very rough and they ought to be very thankful if the plane was not wrecked under these conditions.

Suddenly there was a great splash and water seemed to envelope the plane from everywhere. Immediately following this great splash, as the plane hit those mountainous waves, they found that they were wet from head to foot as if sprayed by a shower. The motors of the plane were kept running in order to obtain steerage way.

After signals were received by the steamship, a line was fired. After two attempts to get this line, another was tied to the end which had pieces of cork set every few feet. After thirty minutes of strenuous effort, the corked rope was finally reached. Our correspondent on the lower deck could be seen tying the container to the end of this rope.

No sooner was the container dropped overboard than the liner's fog-horn could be heard to signal that it was about to continue the trip to New York. Mr. McKean and the pilot were out at sea, desperately tugging at a corked rope to get the white container at the end. Suddenly as they were pulling in the precious cargo, they felt that the weight of the rope had lessened and looking at one another, they knew the answer for this. The container had loosened itself and they were left alone on a rough sea which endangered them every moment while they floated on its surface.

Through some miracle, after frantic maneuvers, they found the container floating on the surface and strapping it in place inside the plane, the pilot immediately had the engines roaring and was on his way back to New York. It was getting dark now and the horizon in the east could barely be seen distinctly, but they were flying at a favorable speed according to the opinion of the pilot.

Unfortunately, as they were nearing Nantucket Light the engines began to sputter, the ship began rocking, the motors went dead and the ship was headed downward to the unseen surface of the inlet near Nantucket Light. Taxying to the barge which sold fuel to Navy ships and planes, they were informed that they could be accommodated with enough fuel to enable them to reach New Haven, Conn., where they could get the rest to take them to New York. This was given in two five gallon cans and upon emptying one into the tank, they ascended into the air.

END.

"A New Idea in Kit Design"
New Boeing P-12 E

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RED BIRD
MODEL AIRPLANE CO.
1918 Emmet St. Omaha, Nebr.

Stresses

(*Continued from page* 306)

P.) is at 29 per cent of the chord, which is 7 inches behind the front beam. Now, as the beams are 24 inches apart and as 7 inches is 29 per cent of 24 inches, this means that one of the beams takes 29 per cent of the load and that the other takes balance of 71 per cent. Naturally, as the load is nearer the front beam, it will take the 71 per cent and the rear beam takes the 29 per cent. Taking the wing load at 250 pounds, as given in the August issue, the front beam would carry 71 per cent of 250 pounds, or 177½ pounds. The rear beam would carry 29 per cent, or 72½ pounds.

This may sound complicated, but if you will try it you can work it out all right.

For determining the L. A. A. condition, we proceed to calculate in the same manner. The center of pressure is now located at 47 per cent of the chord. This puts it at 23½ inches behind the leading edge, or 16 inches to the rear of the front beam. As 16 is 66½ per cent of 24, this means that the rear beam takes 66½ per cent of 250 pounds, or 166 pounds. The front beam takes 33½ per cent or 84 pounds.

It is plain to be seen, that while the front beam in normal flight takes most of the load, there are times when the rear one takes most. As the rear beam is usually smaller than the front beam, careful thought must be given to its design. It is this constant shifting of the C. P. that makes it difficult to design a satisfactory single-spar wing.

We now come to our old friend Load Factor, or "safety factor," as it is often incorrectly termed. There is more confusion about these terms than there should be. By Load Factor we mean roughly that we design something to carry a given number of times the normal load on it.

For instance, if our ship weighed 700 pounds and we wanted a load factor of 10, we would design our beams to carry a load of 10 times 700, or 7,000 pounds. This would NOT be the safety factor, because by violent maneuvers we can put several times the weight of the ship on its wings. With a lightplane this extra weight would be around 3 or 4 times the net weight carried, therefore our true safety factor would only be about TWO.

The minimum load factor for lightplanes that is allowed by the Department of Commerce is 6.5, when we consider the H. A. A. condition. As we found in this condition, the front beam carries a load of 177½ pounds and the rear one 72½ pounds, we multiply these by the load factor of 6.5 and find that the design load for front spar is 1,154 pounds. For rear spar, 471 pounds.

Now, in the L. A. A. condition, the load factor only has to be 65 per cent of what it is for H. A. A. As 65 per cent is 4.23, we do our multiplying by this figure. We found that the front beam carries 84 pounds, so multiplying by 4.23 we get a design load of 355 pounds. For rear spar we get 166 x 4.23, or 702 pounds.

Finally, for the inverted flight (I. F.) condition we must use but 40 per cent of the H. A. A. factor, or 40 per cent of 6.5, which is 2.6. This gives design loads of 461½ pounds for front spar and 188½ for rear.

While all this is quite simple, it may prove confusing at first and the only way to become familiar with it is to use it. Try it on some of your "dream ships." First, determine the net weight to be carried by the wings. Next, find out what part of this is carried by the struts and what part by the pylon or cabane.

After finding the locations of the center of pressure you can determine the various loadings on the spars, after which you multiply by the different load factors. No doubt you will be surprised at the size of some of the figures. For instance, the single spar design shown in the August issue shows the design load in the strut to be 5148 pounds, more than 2½ tons.

END.

Models

(*Continued from page* 328)

side covers are cemented in place and as soon as the cement is dry, both wheel pants should be sanded to conform to the correct shape.

The landing gear struts should be cut from solid wood. When cementing the struts to the pants it may be advisable to put a short legth of pin between them to prevent them from coming apart in hard landings.

The structure of the rudder and stabilizer is similar and the entire outlines are made of balsa. The leading and trailing edges are sanded to conform to the streamlined shape as illustrated in the streamline sections. The stabilizer must be cut back towards the rear a small distance so that it will fit around station No. 6. It is best to leave the stablizer in one piece and cut the rudder post when assembling this part into the fuselage. Cover the stabilizer before assembling. The rudder is fairly thick and the lower part which is a continuation of the fuselage, is carved from a small section of solid balsa.

A finished propeller of 6 inch diameter should be used or one may be carved. The general specifications and carving were illustrated in the August issue. From 4 to 5 strands of 30-gauge x ⅛th inch rubber will be required for the flying model. The nose-bearing is of hand turned wood with a washer cemented to the front and the bearing in turn fits into the nose of the cowl very firmly so that it does not turn.

END.

Practical Lessons

(*Continued from page* 316)

Fabric for the cells is generally made of cotton that is gas proofed by any one of several methods. One method is to line the cells with gold-beater's skin and varnish, these skins being taken from the intestines of cattle and are then cemented in place very carefully. The outer surface may be given a light rubberized coating. Other ships have the cotton chemically treated by a new method that gives a lower diffusion loss than even the gold-beater's skins.

Over the outside of the girders is the covering that streamlines the hull and protects the inner portions from the weather. This need not be gas tight and is therefore weatherproofed cotton fabric, coated with aluminum paint which reflects the heat from the sun and thus shields the internal gas cells from excessive expansions and contractions due to solar radiations.

The size of these rigid ships has apparently no limit. The "Akron," for example, had a total gas capacity of 6,500,000 cubic feet and a length of 785 feet. When inflated with helium, it had a gross aerostatic lift of 403,000 pounds or 201.5 tons. The useful or (net lift) is approximately 182,000 pounds. The "Macon" is even larger than this and neither of the ships approach the maximum possible size or lifting capacity.

Another type of airship, really belonging to the rigid group, is the all-metal ship of which the ZMC-2 is the only example. The envelope is of sheet aluminum alloy, the sheets being riveted together by a special process that makes them gas tight. This outer metal skin therefore performs many functions for it acts as the gas envelope, as a streamlining and as structural member for resisting the various loads. The ZMC-2 is a pressure type rigid ship of 200,000 cubic feet capacity in which the pressure is maintained by air ballonets within the hull.

Special gasoline engines are used for the propulsion of airships, different in some respects from those used on airplanes. Weight is not so much of a factor on airships as on airplanes, hence airship engines are designed with an aim toward fuel economy rather than weight saving. They may be either air-cooled or liquid-cooled, the former being used with the small ships while liquid cooling is applied mostly

LOOK!

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to the large rigid ship. The Akron was provided with eight Maybach liquid-cooled engines which gave her a top speed of 84 m.p.h. and a cruising speed of 50 m.p.h., speeds that are very much lower than those developed by airplanes. She was supplied with enough gasoline to travel a range of 10,580 miles at cruising speed.

With one exception, that of the Graf Zeppelin, gasoline is used as the fuel. The fuel used by the Graf Zeppelin is Blau gas, a gas having a little greater specific gravity than air and which, therefore, does not disturb the trim of the ship when it is consumed by the engines. By the use of this gas as a fuel, it is not necessary to carry water ballast and again, the weight of the gas does not materially place any load on the structure, at least not in the same sense as the loads imposed by gasoline and similar liquid fuels.

The Blau gas drains by gravity from the separate fuel gas cells to the engine because it is heavier than air, and this slight excess of weight over the weight of the air just about compensates for the hydrogen gas loss by diffusion and leakage.

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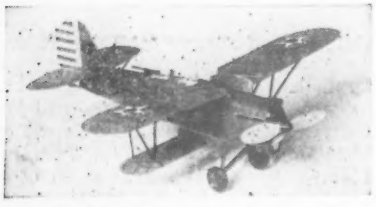

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Aero-Sportswomen

(*Continued from page* 304)

Rio de Janerio. She was so enthused over it that she decided to make the hazardous flight over the Andes to Chile, and later she made the seven-hour continuous journey from Aeroquipo, Peru, to Lima. Again, in the West Indies, when she wanted to visit the Virgin Islands and didn't have time to wait for the regular boat service, she chartered a plane for the trip.

But not satisfied for these amazing experiences for a new air-traveler, Mrs. Keyes induced her magazine to send her on a trip to the Near East where again she took to the skyways.

She flew from Damascus to Bagdad on the French line, but as there were no regular passenger lines in Persia at that time (1931), she flew from Bagdad to Teheran and Istfahan, as far south as Shiraz and back in German freight planes! These may have been efficient but were far from comfortable, as the only room available for passengers was a small space far back in the fuselage behind the freight.

One entered the plane through a trap door in the roof and the only ventilation and light came from two tiny windows on either side. This space was supposed to accommodate only three passengers, but on one five-hour stage of the journey, Mrs. Keyes and her son shared this tiny cabin with a man and his wife and two children!

Although flying is fairly common, even in this land of the Arabian Nights, it is still something like a miracle to be able to cover a distance in eight hours that would have taken two weeks by motor caravan. And it takes a staunch ship to weather the sudden sand-storms of the desert and to climb over 19,000 feet to clear the mountain ranges that encircle the central plains.

"I should like to do all of my traveling by air," Mrs. Keyes said. "It gives a writer an entirely new viewpoint—the world suddenly becomes a much smaller place. Then it is such a practical way to travel, too, you can go so quickly from place to place that you need very little baggage.

"I should like to fly as Will Rodgers does on his assignments, so that I might feel that I was a real influence in encouraging other women to fly."

* * *

THE Women's International Association of Aeronautics gave a reception in their headquarters at the Savoy-Plaza, New York, on July 27, for their organizer and founder-president, Mrs. Ulysses Grant McQueen of Beverly Hills, California.

Mrs. McQueen, who has long been active in aviation circles, attended the annual meeting of the W. N. A. A., which was a part of the National Council of Women's convention in Chicago early in July, then went on to New York where she attended several interesting aviation events.

She flew with Annette Gipson, who led the big aerial formation of seventy-five planes from Roosevelt Field to Montreal to attend the Fifth Annual Canadian Air Pageant. Frank Hawks, Clyde Pangborn, Francis Marsalis, Amy Johnson and many other famous flyers were in the American formation that attended the meet.

While in New York, Mrs. McQueen, who was appointed the first aerial policewoman in 1929, organized an international force of air policewomen, whose chief purpose is to assist women flyers whenever and wherever necessary. A representative of the organization will be appointed in various sections of the country and it will be their duty to furnish weather reports, assist flyers in mapping routes and to go to the assistance of any woman flyer in distress.

There are thirty-two countries represented in this new organization and Amy Johnson was appointed the head of the force.

* * *

Jeannette Lemke, Bay City, Mich., won the race for women pilots at the 40 & 8 All-State Air meet, Flint, Michigan, in August. Miss Margaret Horton of Flint took second place.

* * *

Mae Haizlip, America's premier woman racing pilot, demonstrated her skill once again by taking first place at the International Air Races in Chicago on September 2. Mrs. Haizlip's average speed for the fifty mile course was 191.11 miles per hour, which was some 23 m.p.h. faster than she flew in the Aerol Trophy race in the National races in July.

Florence Klingensmith, who finished second in the woman's race on Sunday, and entered the chief speed event on Labor Day, was killed when the fabric on one wing of her Gee Bee racer gave way while she was traveling at an estimated speed of 220 miles an hour.

As the only woman entered in the event, she had completed three-quarters of the 100 mile course in fourth place and had been leading four of the ablest men pilots of the country. Mrs. Klingensmith, although a pilot of wide experience, had never before competed in an important speed event in which she flew a high powered ship and she was flying a beautiful race when the tragic crash occurred.

Other well known women pilots who attended the races were Gene La Rene, Marty Bowman, Henriette Lantz and Ruth Kitchell Wakeman.

Amy Johnson, who was visiting the Century of Progress, was an interested spectator the opening day, but was unable to remain for the other days as she had to hurry back to New York, where among other things she was scheduled to fly a T.W.A. transport ship from New York to Los Angeles.

END.

Inspectors

(*Continued from page* 304)

had bought the chutes he was using only a few days before and didn't know anything about them with the result that he split the exhibition chute wide open the instant his weight hit the shroud lines. He cracked the Irving and rode it to safety. Then the fireworks started!

Mr. Inspector came out on to that field like a small tornado. He told that jumper in no uncertain terms that had he known those chutes were in the condition they had proved themselves to be he would have never thought of letting him go up, and that to guard against anything like it happening again he could either take his choice of having the pilot of the ship grounded, or signing an affidavit to the effect that he would never again make a premeditated parachute jump in the United States.

Of course, the jumper signed. He didn't want the pilot of the ship grounded because he had all of his money tied up in it. So the jumper signed—and the next day headed for Canada where he spent a profitable summer.

A few days after the incident I met the inspector and because I'm naturally a crusty kind of a mug, I asked him about the deal. He had but one reply.

"You — — parachute jumpers have no business in aviation today; you're a thing of the past. Furthermore, I've known — — (naming my friend) for years and he's no good—and anytime I get a chance to put any of you out of business I'm going to do it. That means that you had better watch your step."

Deep down in my heart I agreed with him that parachute jumpers have no business in the aviation of today, but I was making as much at jumping chutes as I could have made at day labor so I kept on.

But there is a whole lot more to an inspector's job than merely making bad boy pilots hunt holes or inspecting rebuilt crates that have been cracked up. When a ship comes hurtling to the ground and bursts into flame, leaving only a blackened mass of twisted steel tubing and motor and a few charred bodies, it's up to the investigating inspector to find out the cause. He usually does.

I used to know a pilot who was one of the worst boozers that I ever saw. He was worse than most of the old time barnstormers, some of whom used to drink almost all of the time. One of the reasons why this particular pilot hit the bottle so hard was because he had cracked up a few months before by hitting the top of a tree after his motor conked out. That crash broke his leg and his nerve. Yet, because he loved the game, he bought another ship and went back to flying and boozing.

One day, this pilot went up drunk—and after putting on the wildest exhibition of stunt flying that I ever saw, he went into the ground from about twelve hundred feet with throttle wide open.

The inspector for that district arrived the next day, made the usual investigation, and as usual, said nothing. But the next day, back at the home field, he asked some of the boys a few questions.—and found out exactly nothing. Nobody wanted to blacken the name of a dead man, even if he had sort of given us a bad name in the eyes of the local public. Finally he caught me alone and in a casual manner asked:

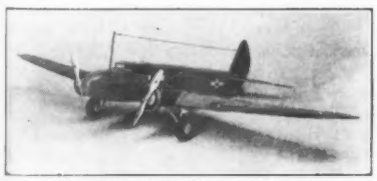
"Tex, had * * * been doing any drinking before he went up the other day? After all, I just about know what happened and I know that he hit the booze pretty regular."

"Inspector, * * * was a pretty good friend of mine. What am I supposed to do?" I asked by way of reply.

He turned away without answering. He knew only too well that the dead pilot had been drunk—so well that he didn't even trouble to talk to the doctor after talking to the boys. He knew that a sober man would have at least closed the throttle and cut the switches.

END.

Lindbergh Model & Supply Co's Authentic **BOEING 247**



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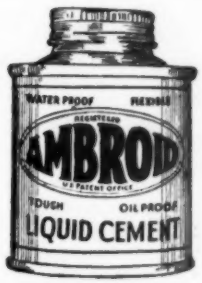

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All Weather Flying

(*Continued from page 290*)

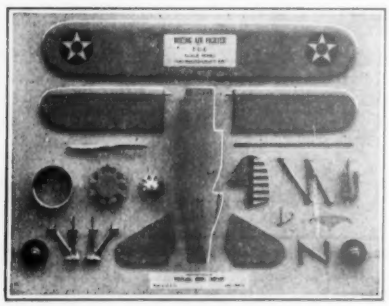
and sharp, he tunes from 344 k. c. (Fresno) to 332 k. c., the frequency on which Oakland broadcasts and flies the beam for Oakland.

As he approaches, he understands that stratus clouds overlie Oakland airport, but that he will have a visibility of 10 miles and a thousand-foot ceiling once he gets below them. So it is safe for him to approach the field and come through the clouds.

Following the beam and approaching the field are, perhaps, the most delicate operations of all his navigational problems. Embryo pilots are taught the rudiments of these procedures before they go onto an airline. Carefully following the beam he finally locates the "cone of silence," which is directly over the beam transmitting station. Knowing his relationship to the field and also with the assistance of the field manager at his remote microphone and the two-way radio communication, he is guided to the proper position for descent through the clouds.

END.

Boeing Air Fighter P-12E



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Climb

(*Continued from page 310*)

loaded only with 15 pounds per horsepower will climb faster than another ship loaded with 20 pounds to every horsepower because in the former case, there will be a greater excess of power. Fast military pursuit ships, which must have a very rapid rate of climb in order to out-maneuver enemy planes, have a very low power loading.

But we must not confuse "steepness" of climb with "rapidity" of climb. A ship can ascend along a steep slanting path and yet not have the climbing rate of another ship that can only ascend along a flatter path. A steep climb, rather than a rapid climb is required of commercial planes that must clear obstacles quickly when taking off from a small field.

Steep climb calls for a low wing loading, or a small weight per square foot of wing surface in addition to a good power reserve. This is contrary to the case of the fast climbing military machine which has both a high power loading and a high wing loading.

As a rule, the steepest climb is had at a horizontal speed that is somewhat less than the optimum speed at which the best rate of climb is had. The angle of attack for the steep climb will be greater than that for the most rapid climb, which of course means a lower forward speed. The steep climb is assisted by the use of wing slots and flaps, or most any other factor that will improve the lift coefficient of the wing although the excess power is less than for the best rate of climb.

There is an approximate formula for the best rate of climb which is based upon the top and stalling speeds. This is as follows:

$$\text{Best climbing speed (m.p.h.)} = C - S \text{ plus } \frac{M-S}{3}$$

Where S=stalling speed. M=Top speed. C=Best climbing rate. This agrees very well with the previous examples given in the graph where this particular ship has a stalling speed of 30 m.p.h. and a top speed of 120 m.p.h. Thus:

$$\text{Best climbing speed} = 30 \text{ plus } \frac{(120-30)}{3}$$

$$= 30 \text{ plus } 30 = 60 \text{ m.p.h.}$$

(*Concluded on page 345*)

Testing Racers

(*Continued from page 292*)

were made to the right. In this airplane the main wing truss was incomplete. The auxiliary wing truss had depended upon a fitting around the center of the continuous rear spar in the upper wing to take unevenly distributed wing loads. A careful inspection showed that the spar had crushed at this point and the bolt holes had elongated.

As a temporary expedient, an eighth inch thick piece of sheet steel was driven between the fitting and the spar to take up the play. This corrected the trouble temporarily, but after a few hours' flying it again appeared due to further crushing of the spar.

The incomplete wing trussing, mentioned above, explains a difficulty experienced when running the 3 km. speed trials. The airplane was clocked at 255 m.p.h. with the direct drive engine Up to 240 m.p.h. no trouble was experienced, but above this speed a tendency to turn to the left and difficulty in removing the airplane from a left bank was observed. A right bank at full throttle gave very little trouble.

The direct drive engine was removed and the 3.2 geared engine installed. The air-speed indicator showed about eight miles per hour more speed with this engine. There was a very strong tendency to roll to the left. The airplane was then rigged very right wing heavy in order to correct this tendency at full throttle, but it is doubtful if it could be handled in a race.

The course was flown in practice for a few laps at 240 m.p.h., then the throttle was gradually opened until wide. A team mate on the ground was instructed to watch until I rocked my wings and then to time the next lap as it would be the only one at full throttle.

Coming down the home stretch, I rocked the stick laterally but the rolling motion of the airplane was so slight that I was afraid my ground observer would not be able to notice it. The 10 mile course in 1931 was an irregular pentagon. The first two pylons were executed successfully but at the third, where the angle was sharper, the left wing would not come up and I was unable to recover from the bank until after overturning. Rolled in to a

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steep right bank to get back on the course and had difficulty getting out of the right.

Banked to the left of No. 4 pylon. The bank increased even with controls reversed and it was necessary to throttle to regain control of the airplane. Obviously the geared engine could not be used in the Thompson Trophy Race. Not because of any torque difficulties but because wing warping at high speeds induced the aileron reversal. This condition became critical at about 260 m.p.h.

In order to check the speed of the airplane with "geared-versus-direct-drive-engine," an attempt was made to fly the 3 km. course. On the first run the airplane gradually rolled to the left until out of control. Throttled and tried again. This time entered the course with the right wing down about 30°. After about 1 km., the airplane was level and at the 2 k. mark the left wing was down some 30° and depressing rapidly.

I throttled and landed, unable to make even one run across the 3km. speed course. It would have been possible to make runs at say 220 m/h and 250 m/h, note the corresponding R. P. M.'s; plot air-speed versus R. P. M. and, knowing that the maximum level flight R. P. M. was 2600, produce the curve and obtain the high speed.

HOWEVER, the Thompson Trophy Race was scheduled for the next day and flights previously made indicated that the direct drive engine could surely be handled, though sloppily, on the course. The engines were changed over night and the morning of race day spent trying to rig the airplane.

The difficulty experienced in test flights and in the race itself indicated that something was loosening up and that the wing warping tendencies were rapidly becoming worse. The airplane was finally rigged very right-wing-heavy to facilitate getting out of left banks and entered in the race. It was forced down in the seventh lap due to overheating and piston failure.

Had we been able to use the cooler running geared engine; had the wing trussing been complete, or the center rear cabane fitting more secure so the wings couldn't warp; had we known as much then as we know now, none of these difficulties would have arisen; but that is experience. The main difficulties in this airplane were:

1. Engine overheating.
2. Wing warping.
3. Poor vision (a. when flying, b. when landing).
4. Insufficient gasoline capacity.
5. Poor takeoff characteristics.
6. Excessive longitudinal stability.
7. It was too slow.
8. Poor cockpit ventilation.

In the 1932 400 Racer these inherent defect were corrected as follows:

1. A longer sharper nose was put on cowling. The engine was adjusted to throw more oil and the oil tank was air cooled.

2. Wing trussing was redesigned and made complete.

3. The pilot was raised 10 inches so he could see over the upper wing. A slide door was arranged in cockpit covering so pilot could stick his head and shoulders out and see ahead when landing.

4. To increase gas capacity, the fuselage was fattened out near the c. g. without decreasing fineness ratio or streamlining.

5. A controllable pitch propeller greatly improved take-off characteristics.

6. The c. g. was moved aft to correct the excessive longitudinal stability.

7. A retractable landing gear was designed and incorporated to increase speed.

8. The cockpit ventilation intake holes were put exactly on the center line of the leading edge.

It seemed that we had corrected all faults in the original design and the first test flight of the redesigned airplane tended to prove our belief correct until time came to land. Then a new problem arose. The landing gear, in ground tests, dropped all the way out and then was spread and locked into place.

In actual flight, the air loads and the rotation of the slip stream spread the gear before it had dropped out, locked it in an intermediate position and it was necessary to make the first landing on the bottom of the fuselage without landing gear. This was corrected by means of a rubber shock cord which held the wheels together until the telescoping struts were fully extended.

In later flights, it was found that the tail fluttered badly when gliding in slowly for a landing. The exact reason for this has not, as yet, been determined, but an effort is now being made to correct it through the use of larger rear fillet between the lower wing and the fuselage. It may or may not work.

There is no work as intensely interesting as testing and improving high speed airplanes. Not even air racing. But I have yet to hear of the first case of anyone engaged in this work dying of old age.

END.

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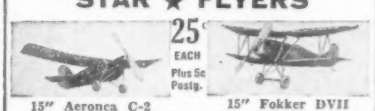

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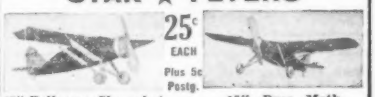

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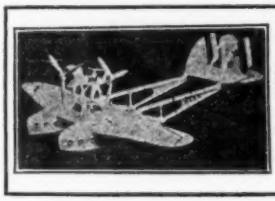

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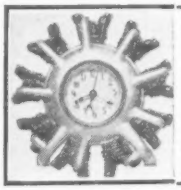

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AIRPLANES

LIGHT BIPLANE WANTED, 2-place, in flying condition. Will also consider monoplane. Will exchange the following articles for this plane: 14-ft. metal sailboat, complete with all equipment; Model 39 Marlin .22 repeater (Mag. broken); Fokker D-7 model with pontoons; Model supplies, balsa, etc.; Spanish guitar and Hawaiian guitar with case, music stand, etc.; 5-ft. Lemonwood bow; Winchester rod and landing net; 350-power microscope with 79 slides; one typewriter in good condition, one Hawthorne flyer bicycle; one pair hockey skates, size 10½ or 9. These articles are worth at least $350.—Jim Ellis, 147 72nd St., Niagara Falls, N. Y.

WACO-90, excellent shape, licensed. Will trade for a late model car. No junk.—R. D. Troutman, Standish, Mo.

LIGHT PLANE WANTED, air-cooled motor, or light plane parts. Will trade: Jig-saw with electric motor; Con C-Melody Saxophone; cost $145; 7 x 7 Army duck tepee tent with sewed-in floor and collapsible poles; 7 x 15 16-oz. tarpaulin; 0.32 Winchester special rifle; bamboo fly-rod and Martin automatic reel; sportsman's hip boots, size 9½; 2 motorcycle engines; 4 motorcycle wheels, 28 x 3; Radiola III; 2 variable condensers, 43 and 23 plates and a 4-wheel trailer coach, new.—L. A. Wilson, Harlowton, Mont.

OX5-YACKEY SPORT-BIPLANE, 2-place, identified. This ship is in A-1 condition with only 10 hours on it since completely recovered. Will trade for a light plane or a car in good condition.—Jay Ackerman, Buckeye, Iowa.

OX5-10. Only 25 hrs. on it since last overhaul and in A-1 condition. Write Geo. Graffunder, Kasota, Minn.

SWALLOW TRAINER (T-P), 2-place, licensed, overhauled and with new prop. This ship is in A-1 condition and flying every day. Excellent covering. Will trade it for an air-cooled ship, or an OX Bird. Will pay cash difference or sell it for $395. Send stamp for photo.—C. J. Dry, 108 Grosvenor St., Athens, Ohio.

STUDENT PILOT TRAINER (Less electric motor), a printing press, National Electric Radio, 4 x 5 Camera, Henderson Motor, S-M radio parts, tenor banjo and 1/3 h.p. General Electric motor. I want in trade for above, Warner motor; parachute; Speed-Graphic, 8 x 10 lens; larger electric motor; .22 target pistol, a licensed air-cooled ship or a ship without a motor.—C. J. Dry, 108 Grosvenor, Athens, Ohio.

LINCOLN SPORT BIPLANE, 30, identified, built by licensed mechanic. Has had only 17 hours, five of them this year. Plane is finished in silver and gold and has a 28 h.p. Lawrence motor which has been recently overhauled. This engine has a double-throw crankshaft installed and has had only one hour's time since overhaul. Streamlined tie-rods, both flying, landing wires and tail brace assembly wires; new wheels, tires and tubes. Covering is off top wing as I have just installed a plywood nose-cap on top wing and tips. Will trade this ship for an aircraft welding outfit, bench lathe or other small lathe and some cash. Will also take an air-cooled engine.—H. A. Tice, 14906 Elm Ave., E. Cleveland, Ohio.

OX-POWERED JOB WANTED, in flying condition but license not necessary. Have Pietenpol Air-Camper (less motor), Model 28 Twin Harley-Davidson motorcycle, Remington typewriter, Cary safe, Bicycles and parts and many other things. Will add some cash.—Dublin Bike Shop, 115 E. Madison St., Dublin, Ga.

AERONCA WANTED, a 2-place ship in flying condition. I will trade a 1929 Chevrolet 1½ ton truck for it. The truck has a steel dump body in excellent condition and has good tires.—E. P. Byer, R. F. D. 1, Covington, Va.

LIGHTPLANE OR SOARING GLIDER WANTED. Will exchange a 32-volt or 110-volt wind-driven lighting plant for it. I also have a fine cornet, violin, large Kodak and a 20 k.w. D.C. Generator.—Prentice Bros., Park Rapids, Minn.

HEATH LIGHTPLANE WANTED. Will trade a Harley-Davidson "74" motorcycle for this ship. Will deliver motorcycle anywhere within 300 miles of Alpena, Mich.—William E. Witter, 820 Chisholm St., Alpena, Mich.

LIGHTPLANE WANTED, Corben Junior Ace or Aeronca, with or without motor. Will trade a Johnson 32 4-cyl. outboard motor with a 16-ft., 5-passenger mahogany runabout boat, all in A-1 condition. Will furnish a photo of same on request. If plane is in good condition, will add cash.—L. E. Townsend, 819 Rose St., La-Crosse, Wis.

LIGHTPLANE PARTS — SUPPLIES

LIGHTPLANE WHEELS WANTED, 18 x 3 or 16 x 4 lightplane wheels, tires and tubes in good condition. What do you want?—Alfred Gardner, 740 W. Main St., Conneaut, Ohio.

FLYING SUIT. I have a $65 winter flying suit, size 44, that is too large for me. Used only six times. I want a Corben Junior Ace kit complete, or what have you?—Box 25, Hopewell, Va.

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PARACHUTE WANTED, exhibition type. What do you want?—Dixon McGinnis, 8733 St. John Ave., Kansas City, Missouri.

PROPELLER WANTED for a Rover or Velie engine; a Stromberg Carburetor, No. NAR-3 and a set of new spars for a Pietenpol wing. I have one pair of airplane onewheels 20 x 4, with tires and tubes; one new Pioneer compass, cost $75 one set of Clark Y ribs for Corben Baby Ace; one new tachometer cable for Pioneer tach., etc.—John R. Bell, R. F. D. 2, Belle Vernon, Pa. (0)

BARLING FUSELAGE, low-wing type, uncovered. Complete tail surfaces, covered; cowling, controls and other parts, slightly cracked. Also complete M. G. H. high-wing mono. fuselage and tail surfaces. Will swap either for 1932-33 motorcycle or what have you—Charles Jensen, Western Airmotive Service, 1427 52nd St., Sacramento, Calif. (0)

WHEELS, practically new 24 x 4 drop-center wire wheels, complete with tires, tubes, streamliners and bushings for either 1-in. or 1⅝-in. axle. Will trade for one pair of 18 x 3 wheels, tires and tubes in same condition. I also want a deep case for Henderson engine.—William Holmes, Lewisburg, N. C.

CLARK Y. RIBS. I have 26 of these ribs built for a Church mid-wing lightplane. Will trade them for home wood-working machines. A small planer or jointer is wanted.—Charles Hunter, 189 E. Main St., Salineville, Ohio.

AIR-CAMPER FUSELAGE, 2-place, spruce, seats, motor mount, rudder and elevators. Will swap for models, supplies or what have you?—Charles Hascup, 116 Essex St., Hackensack, New Jersey.

LIGHTPLANE FUSELAGE WANTED, a Taylor Cub or Corben preferred. What do you desire?—Emil Bryson, Box 313, South Hill, Va.

LIGHTPLANE WINGS, an outboard engine, an OX5 engine, a Henderson engine, rifles, chemical formulae, plans, shortwave converter, radio parts, jig-saw, Mirrorscope projector, 6-volt fan. What have you?—Orville Kinsley, 802 16th St., Niagara Falls, N. Y.

AUTOMOBILES

MIDGET CAR PARTS wanted, wheels, axles, and other parts. I will trade relics, guns and cash.—Jack Owens, Calhoun, Ky.

OLDSMOBILE RACER in good shape, all new tires, underslung, motor has 4,000 miles on it. Will trade for any kind of sportplane.—Bill Mahar, Hettinger, N. Dak. (0)

1930 CHEVROLET COUPE, 6-cyl., to trade for a Curtiss Junior, Buhl Pup or any licensed airplane with a Szekely engine or other engine of about that horsepower. Willing to pay a little cash difference out of a steady income.—Edw. H. Johnson, 64 Grand St., Springfield, Mass. (X)

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FILM DEVELOPING OUTFIT, complete with tanks, trays, powders, cards, instructions, etc. Will trade it for boxing and wrestling books and magazines.—Jack Quelle, 1123 Franklin St., Burlington, Iowa.

HIGH-POWER FIELD GLASSES WANTED. I have an electric jig-saw, model planes, plans, model supplies, radio material. What do you want?—Wayne Evans, 1030 East A St., Salina, Kansas.

EASTMAN HAWKEYE CAMERA to exchange for seven 6-in. replica models. Must show good workmanship.—Louis Forstner, 4640 N. 13th St., Philadelphia, Pa.

ENGINES AND ACCESSORIES

GASOLINE BICYCLE ENGINE, 1 or 2-cyl., in running order and suitable for small auto. Will trade a 30-in. model of Curtiss Hawk P6E or a Hell-Diver.—Howard Roberts, Rt. 1, Box 419, Fresno, Calif. (0)

LIGHTPLANE ENGINES WANTED. Szekely, Heath, Church, Erwin, Cleone, Model A Ford or other lightplane motor. Also need small wheels, tires, tubes, turnbuckles, etc. Will trade other airplane parts or will pay spot cash. What do you want?—Kamm Aircraft Company, 819 Fifteenth St., Oshkosh, Wis.

LIGHTPLANE ENGINES WANTED. Also equipment and parts. Will trade almost anything.—Furey-Diehl, 255 Maple Way, Sharon, Pa.

HEATH-HENDERSON WANTED, or B-4 with prop. What do you want?—Frank Baumstark, Glen Ullin, N. Dak. No. 313.

CONTINENTAL A-40 WANTED, a Szekely 35, or similar motor, complete with propeller. State price, condition and approximate number of hours used. What do you need?—William Holmes, Lewisburg, N. C.

CARBURETOR WANTED, (NA-R3 or NA-S3) Stromberg for Szekely 30 h.p. engine. I also need a Marshall-Fahlin propeller for this engine. Will pay cash or trade Irwin Meteor-motor with prop and Heath parts. Also need tachometer, temp. gauge and other instruments.—Stanley Lamar, Hagerstown, Ind.

MOTORCYCLE ENGINE WANTED, 2-cyl., Harley twin preferred. Must be in good running condition. I will trade a complete shortwave set, easily worth $75, with Zenith eliminator and battery.—Joe Molitor, Gaylord, Minn.

J-6-9 WRIGHT AIRCRAFT ENGINE, 300 h.p., with standard steel propeller in "like new" condition. Only 154 hours use. I want a late model air-cooled airplane. Must be licensed.—Frank Hoffman, 240 West Utica St., Buffalo, New York.

HEATH-HENDERSON CONVERSION, complete, only 27 hours. The damaged Heath "as is" or rebuilt by A. & E. mechanic. Any part of fuselage, empennage, tires, etc. Will consider an outboard engine.—O. R. Aslakson, Sheyenne, North Dakota.

NEW KINNER ENGINE (K-5), 100 h.p., front exhaust. Engine in original factory crates. Will trade for a 2-place light licensed aircraft. Aeronca or Alexander Fly-About preferred.—Tom Rocklin, 37 Naval Ave., Buffalo, N. Y.

AIRCOOLED "FOUR" ENGINE, 50 h.p., suitable for Pietenpol Air-Camper, Corben Baby Ace. 1-place cabin monoplane incomplete. Want a good car, Plymouth coupe preferred. Describe fully. Lawrence Allison, 928 Louisiana St., Lawrence, Kas.

HEATH ENGINE WANTED. I have a Mead primary glider in fair flying condition; pair of 26 x 4 wheels, tires and tubes; Iver Johnson 0.22 cal. revolver; Dyke's "Aircraft Engine Instructor" and Page's Modern Aircraft.—Goodwin Carlson, Garvin, Minn.

MOTOR-BIKE ENGINE WANTED, or the equipment necessary for converting an ordinary bicycle into a motor-bike. What do you want? —Arnold Miller, 275 Maple Ave., Hamburg, New York.

MOTOR WANTED, 1 to 3 h.p., preferably a 1-cyl. motorcycle engine. What do you want in trade?—Roland Hoover, Princeton, Ill.

BRITISH PURSUIT PLANE ENGINE, 7-cyl. radial air-cooled engine, Dual magneto, Dual exhaust valves. Complete except carburetor. In excellent condition, weight 320 lbs. Will take $85 cash, a small quick-change gear lathe, small pre-war water-cooled aviation engine or an ancient car, older than 1908.—Watt, 77 W. Milton, Hazel Park, Mich.

MISCELLANEOUS

WANTED—Collie dog or rifle. Have aviation magazines, gas engine, $12 Irish Mail, Fishing Poles, Phonograph, Kriss-Kross, Books, Magazines, Bugle, Ice Skates. Describe what you have and we'll dicker.—Edward Ogawa, Lava Hot Springs, Idaho.

NEW 6-VOLT STORAGE BATTERY, 0.22 revolver, Stromberg carburetor, for Model T. crankcase and timing gears for Indian Twin. Will trade for Indian Twin magneto, Carburetor, battery or generator. Let me know what you have and what you want.—George Gadren, 416 Viola St., Camden, N. J.

INSTRUCTION in muscle building, correct thinking, money-making plans, success rules and curing ailments will be exchanged for lightplanes, equipment or anything of value.—Alan R. Upton, P. O. Box 63, Warm Springs, California.

HARD WORK anywhere in the U. S. A. will be exchanged for a flying or mechanic's course, by a youth of 19.—Frank A. Williams, Pershing Ave., So. Hadley Falls, Mass.

AUTOMATIC, 0.25 H. & R., 0.38 Iver Johnson Hammerless revolver, punching bag, violin, models, and other things. Am interested in photography, aviation, chemistry, model building or the like. What have you?—Ralph Lee, 501 E. Illinois St., Bellingham, Wash.

AVIATION COURSE WANTED. What do you want?—Luis Gautier, Box 801, Mayaguez, Puerto Rico.

GOLD MINE, worth $400,000, filled in by eccentric owner before death. Should be easily located from the air, will exchange one-third interest for help in locating lost shaft and assistance in operating said mine.—Dr. Phillips de Hesse, 2544 East 79 St., Chicago, Ill.

CARTOONS. I will draw pen, and ink cartoons, original or copies for Aviation Magazines. I will draw for any magazine, free of charge.—Robert J. Allen, 33 Taylor St., Pontiac, Mich.

SAILBOAT, 8-ft. sailing dingy, fast and able, complete equipment, new this season. Also two big airplane scrapbooks and 20 assorted airplane and mechanical magazines of late dates. Will trade all of these items for a midget car that can be shipped to me.—R. Arbib, 115 Lafayette Place, Woodmere, L. I., N. Y.

NORTHROP PRIMARY GLIDER, identified. Will trade for a Harley-Davidson motorcycle, 1929 or 1930 model, a lightplane or what have you?—Edmund Faris, Box 99, Green End Ave., Newport, R. I.

MECHANIC, both licenses, graduate A. C. T. S. in eng., experienced as an instructor in shop; wish work in shop or overhauling; sober, reliable and can furnish excellent references.—Walter W. Vallowe, 6352 Maryland Ave., Chicago, Ill.

MODELS AND SUPPLIES

CLEVELAND MODEL PLANS WANTED. I want C. D. model plans of the Polish Fighter, Albatros, Hawker Fury, etc., also copies of English Flight Magazine.—Val Werges, 4806 Milentz Ave., St. Louis, Mo.

MODEL AIRCRAFT of all kinds. What do you want? What have you got?—G. S. Aircraft Supply, Deer Park Ave., Babylon, L. I., N. Y.

MODEL AIRPLANE SUPPLIES WANTED. I have many fine things to trade, too numerous to mention here.—Fred Petrovich, 253 Clinton St., Binghampton, N. Y.

FINISHED MODEL, Cee-Dee Laird Super-Solution. Will trade for a set of Ed. Borntraeger's front drive midget car plans.—Harold Hemer, California, Ohio.

MOTORCYCLES

MOTORCYCLE WANTED, prefer an Indian but will consider others. Will trade a good running OX5 engine for the motorcycle.—The Weller Garage, 5429 W. 63rd St., Chicago, Ill.

MOTORCYCLE WANTED. Have a 2-place Mead Kiyak, 14½ ft. long; cost $30. Also a 9½-ft. Hartzell Walnut prop, copper tipped; two name card printing presses, an oil painting of Richtofen's Red Fokker in action. The motorcycle must be an Indian or Harley of 1927 or later, in good running condition.—Reno Benner, 3046 Mascher St., Philadelphia, Pa.

MOTORCYCLE WANTED, in good condition. I have many things to trade. What do you want?—Wolffe Roberts, Amherst, N. H.

BICYCLE CYCLEMOTOR. Will trade for auto mechanic's tools, a home type or auto radio.—A. Karst, 2931 Lansing Drive, Dayton, Ohio.

WILL TRADE 1930 HARLEY, 74 H. C., for Salmson A-D-9, Szekely, or 60 h.p. Anzani in good condition. Or will trade for complete K. D. kit of Gere biplane parts. Will trade a 2-cyl. Harley opposed engine for 2-cyl. Lawrence or 3-cyl. Anzani needing some repairs. What have you?—W. Young, 1522 Orthodox St., Philadelphia, Pa. (2)

MOTORCYCLE WANTED. A Harley-Davidson, 1930 up, Model 74. Good condition. Radio and cash to trade.—Bill Williams, 1 Hedrick St., Lanett, Ala.

MUSICAL INSTRUMENTS

BANJO. Will trade a new Gibson tenor banjo with case, but minus head, for a standard make of portable typewriter.—Stanley Stewart, Kelly Field, Texas.

NEW SPANISH GUITAR. I will trade guitar for gasoline motor to be used for ice sled. Must be perfect.—Otis H. Pineo, Jr., 19 Tuinapoxet Lane, Worcester, Mass.

BEAUTIFUL CONN CORNET, Violin and large Kodak. Will trade one or all for Harley or Henderson motorcycle or lightplane.—Prentice Bros., Park Rapids, Minn.

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WIRELESS TRANSMITTER, 25 watt output, complete and in working order. Will trade for a used canoe in good condition, preferably with sponsons.—Alvin Abrams, 570 W. 191 St., New York City, N. Y.

AUTO RADIOS. Have several Sparton, Atwater-Kent and Philco auto radios. Will trade for lightplane parts or engines.—Norman McKernan, Galena, Ill.

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LARGE STAMP COLLECTION which contains over 1,200 stamps mounted in a modern album (Scott's latest) will be exchanged for a large collection of U. S. revenue, postage, etc.—Julian Armstrong, Jr., Box 197, Lake Forest, Ill.

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Ship-Shape

(*Continued from page* 312)

engine and should receive as much care.

To begin with, always keep her clean. Dirt on the fabric, or oil and gas soaked fabric, wrecks the dope finish, and causes it to crack and deteriorate rapidly. If it can be helped, don't wipe the oil or dirt off with gasoline, for gas will dull the finish and damage both fabric and dope.

All inspection plates should be tight and sleeves or covers of some sort provided for openings around the tail skid, wire holes and openings etc. to prevent dust and dirt entering the interior and spoiling the fabric.

Oil all movable connections, joints etc. to prevent wear from friction, particularly landing gear and control connections, and wash down with gas frequently to keep the grease or oil from collecting dirt and forming an abrasive mixture that will wear out joints and connections in short time.

Grease the axles frequently and all control connections. Wipe all control cables with graphite grease to prevent rust. Use graphite grease for the pulleys, and use plenty so the pulleys will have no tendency to stick or bind. Don't forget the hinges on the ailerons and tail surfaces. Use hard grease or a small amount of heavy oil, and see that they work freely.

You might try going over your ship about every two weeks or so to see that everything is oiled correctly, and to check up on the fittings connections, etc. Complete absence of friction is essential for proper operation to prevent both wear or possible failure. With parts designed almost to the limit of strength there can be little wear before failure results.

Take care of any rips, holes or tears in the fabric immediately, so there will be no danger of the wind ripping the the fabric off the ribs.

END.

Climb

(*Continued from page 338*)

This checks up with the optimum speed (A) in the graph. The speed for steepest climb will be in the neighborhood of 50 m.p.h. for this particular airplane.

Next comes the consideration of wind in its relation to climbing, which gives rise to apparently conflicting ideas, but which is really quite simple. First, the climbing speed and steepness so far as the air-speed is concerned is always the same, wind or no wind. If we do not take the earth into account, but simply the climb in the air, then we will find that the rate of climb is not affected in the least by the velocity nor the direction of the wind.

But, when the earth is taken as a reference point, as in estimating the steepness of the climb just after take-off, then the direction and velocity of the wind will have a great influence on the steepness of the flight path. This is due to the fact that wind velocities are measured in relation to points on the earth which immediately connects the climbing rate with the earth.

Just as a comparison, Fig. 8 shows a diagram at the right where the plane (Y) is taking off against the wind while an exactly similar plane (X) at the left is taking off in the direction of the same wind. Both planes take off from the same point (A) and both of them have the same climbing speed of 800 feet per minute in still air. The still air speed of both ships is 100 m.p.h. while the speed of the wind is 30 m.p.h. from right to left.

At the right, the climb in still air is along the path (A-C), but when combined with the wind component (E-C), the angle of the path is increased with the steeper path (A-E). Thus, climbing against the wind enables the plane (Y) to clear the tall building at the right which would have been impossible in still air. Flying against the wind improves the steepness of the climb.

At the left, the flight path in still air is (A-B), exactly the same as (A-C) at the right. But, adding the 30 M.P.H. wind vector (D-B), gives us a new flight path (A-D), much flatter or less steep than the still air path (A-B). In fact, the plane (X) is just barely able to clear the low tree which it could have done easily with a good margin in still air.

Of course, all of these remarks apply to climbing conditions at or near a constant elevation, such as sea-level. When the elevation is very materially increased, say by 5,000 feet, then the changes in air density make themselves known and influence the rate of climb. The air density and temperature continually and uniformly decrease with every increase in elevation.

END.

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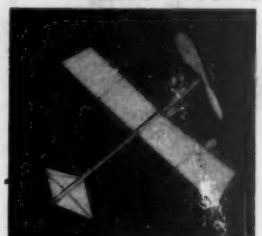

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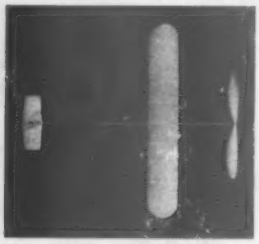

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